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AN INTERNATIONAL JOURNAL FOR RESEARCH ON
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Volume LXI January-March 1997

CONTENTS

Fungal flora of the Daba Mountains:

Introduction .... **Wen-ying Zhuang** 1
Discomycetes .... **Wen-ying Zhuang** 3
Imperfect fungi .... **Ying-lan Guo** 13
Macromycetes .... **Hua-an Wen** 35
Aphyllophorales and some Basidiomycota .... **Xiao-qing Zhang** 41
Ustilaginales .... **Lin Guo** 47
Uredinales .... **Ning Zhang, Jian-yun Zhuang, and Shu-xia Wei** 49

Myrothecium renaudii sp. nov. on *Heliconia psittacorum* × *H. spathocircinata.* **Franklin Escalona** 81

Three new species of *Hyperphyscia* (Physciaceae, lichenized Ascomycotina), with a revision of *Hyperphyscia adglutinata* .... **Nora C. Scutari** 87

The lichen genus *Rinodina* in Belgium, Luxembourg and the Netherlands. **Mireia Giralt, Pieter P. G. van den Boom, and Mario Matzer** 103

Studies on western American Pezizales. Collecting and describing ascomata – macroscopic features .... **Nancy S. Weber, James M. Trappe, and William C. Denison** 153

Protodaedalea, a synonym of *Elmerina* (Heterobasidiomycetes) .... **Maria Núñez** 177

Aspergillus caelatus, a new species in section *Flavi* .... **Bruce W. Horn** 185

Notes on *Acaulospora bireticulata* (Glomales, Zygomycetes) found in Poland. **Janusz Błaszkowski** 193

Designation of epitypes for *Laccaria proxima* and *Laccaria tortilis* (Agaricales). **Gregory M. Mueller** 205

Mycological notes, II. Neotypification of *Hebeloma cistophilum*, a mediterranean pleurocystidiate species, and combination of *Hebeloma cremeopallidum* (Esteve-Rav. & Heykoop) comb. nov. .... **M. Heykoop and F. Esteve-Raventós** 209

Vibrissea pfisteri, a new species with an unusual ecology .... **Teresa Iturriaga** 215

A preliminary discomycete flora of Macaronesia: Part 10a, Dermateaceae. **Teresa Iturriaga and Richard P. Korf** 223

A revision of the genus *Daldinia*. **Yu-Ming Ju, Jack D. Rogers and Felípe San Martín** 243

Amplified description and lectotypification of *Poronia ehrenbergii* (Xylariaceae, Hymenoascomycetes) .... **J. C. Coetzee and A. Eicker** 295

Bahusutrabeeja bunyensis sp. nov. (Hyphomycetes) from Queensland, Australia, and a new name for *Chalara australis* McKenzie .... **E. H. C. McKenzie** 303

Chaetosphaerulina bambusae spec. nov. (Pleosporales) from India. **Alaka Pande and V. G. Rao** 307

Spanish hyphomycetes XVI. Some aero-aquatic conidial fungi. **S. K. Abdullah, J. Guarro, M. J. Figueras, and E. Descals** 311

[Contents continued inside front cover]

ISSN 0093-4666 MYXNAE 61: 1-508 (1997)

For subscription details, availability in microfilm and microfiche, and availability of articles as tear sheets, see back cover.

[Contents continued from front cover]

Notes on conidial fungi. XI. Two new species of *Cheiromoniliophora* and *Oncopodium*. **R. F. Castañeda Ruíz, J. Guarro, and J. Cano** 319
Ultrastructure and classification of the genus *Sorodiscus* (Plasmodiophoromycetes). **Russell K. Robbins and James P. Braselton** 327
Epulorhiza inquilina sp. nov. from *Platanthera* (Orchidaceae) and a key to *Epulorhiza* species........................ **R. S. Currah, L. W. Zettler, and T. M. McInnis** 335
Cercinomyces curvisporus sp. nov. (Dacrymycetales) from Yunnan, China. **Nitaro Maekawa and Mu Zang** 343
New *Paraphaeosphaeria* species and their anamorphs .... **Annette W. Ramaley** 347
Melanotaenium adoxae revisited .... **G. Negrean and O. Constantinescu** 359
Notes on hyphomycetes. LXXIII. Redescription of *Phaeoramularia coalescens*, *Phaeoramularia eupatorii-odorati* and *Phaeoramularia pruni* **Gareth Morgan-Jones** 363
Pertusaria velata (Turner) Nyl. and its synonyms. **Alan W. Archer and Maria Ines Messuti** 375
Exoperidium and spores of *Calvatia utriformis*.............................. **María P. Martín** 381
The genus *Amanita* (Amanitaceae, Agaricales) in Zambia. **D. N. Pegler and D. Shah-Smith** 389
A name change for *Coltricia pusilla* (Aphyllophorales)..................... **Jorge E. Wright** 419
Taxonomy of *Daedalea xantha* comb. nov...................... **Anjali Roy and A. B. De** 421
Allozyme characterization of some terfeziaceous fungi (Pezizales, Ascomycotina). **Giovanni Pacioni, Giuliano Frizzi, Michele Miranda, and Hassan K. El-Kholy** 427
Weddellomyces protearius sp. nov. et *Lichenochora xanthoriae*, champignons lichénicoles non lichénisés parasites de *Caloplaca proteus*. **Pere Navarro-Rosinés and Claude Roux** 433
Bellemerella trapeliae gen. et sp. nov., ascomycète lichénicole non lichénisé (Verrucariales, Verrucariaceae).......................... **Pere Navarro-Rosinés and Claude Roux** 441
Three new species of Opegraphaceae (Lichens) from the Namib desert. **J. M. Egea, E. Sérusiaux, P. Torrente, and D. Wessels** 455
CORTBASE – a nomenclatural taxabase of corticioid fungi (Hymenomycetes). **Erast Parmasto** 467
New reports of the genus *Pluteus* (Agaricales) from Mexico. **Olivia Rodríguez, Ofelia Vargas, and Laura Guzmán-Dávalos** 473
A new species of *Serenomyces* from date palm in California. **Margaret E. Barr, Howard D. Ohr, Donald M. Ferrin, and Manuel Mundo-Ocampo** 481
Pertusaria spilota, a new lichen species (lichenised Ascomycotina) from New Zealand. **Alan W. Archer and William M. Malcolm** 485
Book Reviews .... **D. S. Hibbett** 487
NOTICE: K. Vánky, Ustilaginales Exsiccata No. 1000...................... **Kálmán Vánky** 493
Author Index 494
Errata 496
Index to Fungous and Lichen Taxa 497
Reviewers 508
Publication Date, Volume 60... 508

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ERRATA

VOLUME SIXTY-ONE

Page 19, line 19	for	*Pernospora*	read *Peronospora*
Page 501	for	*Gyromitra esculaenta*	read *Gyromitra esculenta*
Page 508	for	*Pernospora obliqua*	read *Peronospora obliqua*

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TABLE OF CONTENTS, VOLUME SIXTY-ONE

January-March, 1997

Fungal flora of the Daba Mountains:

Introduction .... **Wen-ying Zhuang** 1
Discomycetes.. **Wen-ying Zhuang** 3
Imperfect fungi.. **Ying-lan Guo** 13
Macromycetes.. **Hua-an Wen** 35
Aphyllophorales and some Basidiomycota .... **Xiao-qing Zhang** 41
Ustilaginales.. **Lin Guo** 47
Uredinales .... **Ning Zhang, Jian-yun Zhuang, and Shu-xia Wei** 49
Myrothecium renaudii sp. nov. on *Heliconia psittacorum* × *H. spathocircinata*.
Franklin Escalona 81
Three new species of *Hyperphyscia* (Physciaceae, lichenized Ascomycotina),
with a revision of *Hyperphyscia adglutinata* .... **Nora C. Scutari** 87
The lichen genus *Rinodina* in Belgium, Luxembourg and the Netherlands.
Mireia Giralt, Pieter P. G. van den Boom, and Mario Matzer 103
Studies on western American Pezizales. Collecting and describing ascomata – macroscopic features
Nancy S. Weber, James M. Trappe, and William C. Denison 153
Protodaedalea, a synonym of *Elmerina* (Heterobasidiomycetes)....... **Maria Núñez** 177
Aspergillus caelatus, a new species in section *Flavi* .... **Bruce W. Horn** 185
Notes on *Acaulospora bireticulata* (Glomales, Zygomycetes) found in Poland.
Janusz Błaszkowski 193
Designation of epitypes for *Laccaria proxima* and *Laccaria tortilis* (Agaricales).
Gregory M. Mueller 205
Mycological notes, II. Neotypification of *Hebeloma cistophilum*, a mediterranean pleurocystidiate species, and combination of *Hebeloma cremeopallidum* (Esteve-Rav. & Heykoop) comb. nov.
M. Heykoop and F. Esteve-Raventós 209
Vibrissea pfisteri, a new species with an unusual ecology......... **Teresa Iturriaga** 215
A preliminary discomycete flora of Macaronesia: Part 10a, Dermateaceae.
Teresa Iturriaga and Richard P. Korf 223
A revision of the genus *Daldinia*.
Yu-Ming Ju, Jack D. Rogers and Felípe San Martín 243
Amplified description and lectotypification of *Poronia ehrenbergii* (Xylariaceae,
Hymenoascomycetes)............................ **J. C. Coetzee and A. Eicker** 295
Bahusutrabeeja bunyensis sp. nov. (Hyphomycetes) from Queensland, Australia,
and a new name for *Chalara australis* McKenzie.......... **E. H. C. McKenzie** 303
Chaetosphaerulina bambusae spec. nov. (Pleosporales) from India.
Alaka Pande and V. G. Rao 307
Spanish hyphomycetes XVI. Some aero-aquatic conidial fungi.
S. K. Abdullah, J. Guarro, M. J. Figueras, and E. Descals 311
Notes on conidial fungi. XI. Two new species of *Cheiromoniliophora* and
Oncopodium.............. **R. F. Castañeda Ruíz, J. Guarro, and J. Cano** 319
Ultrastructure and classification of the genus *Sorodiscus* (Plasmodiophoromycetes).
Russell K. Robbins and James P. Braselton 327
Epulorhiza inquilina sp. nov. from *Platanthera* (Orchidaceae) and a key to
Epulorhiza species.... **R. S. Currah, L. W. Zettler, and T. M. McInnis** 335
Cercinomyces curvisporus sp. nov. (Dacrymycetales) from Yunnan, China.
Nitaro Maekawa and Mu Zang 343
New *Paraphaeosphaeria* species and their anamorphs........ **Annette W. Ramaley** 347
Melanotaenium adoxae revisited........... **G. Negrean and O. Constantinescu** 359

Notes on hyphomycetes. LXXIII. Redescription of *Phaeoramulariacoalescens*, *Phaeoramulariaeupatorii-odorati* and *Phaeoramulariapruni*
Gareth Morgan-Jones 363
Pertusaria velata (Turner) Nyl. and its synonyms.
Alan W. Archer and Maria Ines Messuti 375
Exoperidium and spores of *Calvatiautriformis*...................... **María P. Martín** 381
The genus *Amanita* (Amanitaceae, Agaricales) in Zambia.
D. N. Pegler and D. Shah-Smith 389
A name change for *Coltriciapusilla* (Aphyllophorales)............ **Jorge E. Wright** 419
Taxonomy of *Daedaleaxantha* comb. nov. .... **Anjali Roy and A. B. De** 421
Allozyme characterization of some terfeziaceous fungi (Pezizales, Ascomycotina).
Giovanni Pacioni, Giuliano Frizzi, Michele Miranda, and Hassan K. El-Kholy 427
Weddellomyces protearius sp. nov. et *Lichenochora xanthoriae*, champignons lichénicoles non lichénisés parasites de *Caloplacaproteus*.
Pere Navarro-Rosinés and Claude Roux 433
Bellemerella trapeliae gen. et sp. nov., ascomycète lichénicole non lichénisé (Verrucariales, Verrucariaceae) . **Pere Navarro-Rosinés and Claude Roux** 441
Three new species of Opegraphaceae (Lichens) from the Namib desert.
J. M. Egea, E. Sérusiaux, P. Torrente, and D. Wessels 455
CORTBASE – a nomenclatural taxabase of corticioid fungi (Hymenomycetes).
Erast Parmasto 467
New reports of the genus *Pluteus* (Agaricales) from Mexico.
Olivia Rodríguez, Ofelia Vargas, and Laura Guzmán-Dávalos 473
A new species of *Serenomyces* from date palm in California.
Margaret E. Barr, Howard D. Ohr, Donald M. Ferrin, and Manuel Mundo-Ocampo 481
Pertusaria spilota, a new lichen species (lichenised Ascomycotina) from New Zealand .... **Alan W. Archer and William M. Malcolm** 485
Book Reviews.. **D. S. Hibbett** 487
NOTICE: K. Vánky, Ustilaginales Exsiccata No. 1000 .... **Kálmán Vánky** 493
Author Index.. 494
Errata 496
Index to Fungous and Lichen Taxa 497
Reviewers.. 508
Publication Date, Volume 60 508

MYCOTAXON

Volume LXI, pp. 1-2 January-March 1997

FUNGAL FLORA OF THE DABA MOUNTAINS: INTRODUCTION

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Institute of Microbiology, Academia Sinica, Beijing 100080, China

An expedition was arranged in the Daba Mountain areas in August, 1994, supported by the Special Foundation for Floral and Taxonomic Studies, Chinese Academy of Sciences. The areas investigated were between Shennongjia, Hubei Province and the Qinling Mountains of Shaanxi and Gansu provinces including Wuxi of Sichuan and Zhenping, Pingli and Langao of Shaanxi, at the altitude of 450-2050 m. The weather was extremely dry and hot during the period of our visit and some of the fungi had already dried out in the forests before collection. About 900 specimens were collected, containing 54 of Agariales and Gasteromycetes, 66 of Aphyllophorales, 500 of rusts, 24 of smuts, 28 of discomycetes, 200 of leaf-inhabiting imperfect fungi and 26 of others groups. Among these present Daba Mountain fungal specmins, 303 species of 117 genera were identified, among which 6 new taxa and 16 new records for China were found.

A set of 6 papers dealing with different groups of fungi from the Daba Mountains are provided following this introduction. They indicate the currently known species of the areas, which is, by no means, a complete list of fungi in the area but those encountered during the 1994 field trip. Many species are expected to be found in further investigations of both explored and unexplored places in the Daba Mountains.

The authors of the following 6 papers acknowledge gratefully Prof. Richard P. Korf, Cornell University, USA for his critical reviews and valuable suggestions on these papers.

大巴山真菌：引言

摘要　继对大巴山主峰神农架和秦岭地区深入的真菌资源调查之后，在中国科学院生物分类区系特别支持费的资助下，1994年8月我们对大巴山中部和西部地区的真菌进行了为期一个月的考察，填补了该地区真菌研究的空白，使我们对秦巴山区的真菌有了比较完整和全面的了解。此次调查的地区包括四川巫溪、陕西镇坪、平利和岚皋，海拔为450-2050米，尽管该年夏季气候罕见的酷热和缺雨，以至某些林中真菌在采集时已经完全干燥，我们仍然获得高等担子菌、锈菌、黑粉菌、盘菌、寄生半知菌等标本约900号。鉴定出117属303种真菌，其中包括5个新种、1个新变种和16个中国新记录种。后面连续的六篇文章中报道的大巴山各种不同类群的真菌，仅代表大巴山已知真菌的一部分，在已调查和未涉足的地区还有大量未知真菌等待我们去发现。

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FUNGAL FLORA OF THE DABA MOUNTAINS: DISCOMYCETES

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ABSTRACT Nineteen species of discomycetes are reported for the first time from the Daba Mountains. Among them *Lachnellula dabaensis, Psilopezia dabaensis* and *Rutstroemia dabaensis* are new species and *Jafnea semitosta* and *Lachnum pudibundum* are new records of China.

摘要　大巴山的盘菌过去几乎没有报道，在1994年真菌调查工作进行之前，中国科学院微生物研究所真菌标本室保存的大巴山标本仅有4号。在大巴山主峰神农架、大巴山中西部、秦岭这一条贯穿中国东西的山脉体系中，盘菌种类并不完全相同。据对现有材料的观察，除了马鞍菌 (*Helvella cripa*)、宾州盾盘菌 (*Scutellinia pennsylvanica*)、佩克杯盘菌 (*Ciboria peckiana*) 和小孢绿杯菌 (*Chlorociboria aeruginascens*)在上述三个地段都有分布外，其他种类各有特点。其中神农架地区1984年曾做过为期四个月深入细致的考察，收集到的材料十分丰富，已出版专著；秦岭地区调查历史较早，工作进行得比较彻底，该地区的名录也即将问世；对大巴山中西部的调查实属首次，虽受不利气候条件的影响，收获仍然很大，对28份新采集到的和原有盘菌标本进行观察后，鉴定出15属19种，其中新种3个 (大巴长生毛盘菌 *Lachnellula dabaensis,* 大巴滑盘菌 *Psilopezia dabaensis,* 大巴蜡盘菌 *Rutstroemia dabaensis*)，中国新记录种2个 (半南费盘菌 *Jafnea semitosta,* 耻粒毛盘菌 *Lachnum pudibundum*)。

Discomycetes in the Daba Mountains were seldom reported. There were only 4 old collections of cup-fungi kept in the Mycological Herbarium, Institute of Microbiology, Academia Sinica (HMAS). Although

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* Partially supported by the Special Foundation for Floral and Taxonomic Studies, Chinese Academy of Sciences and the National Natutal Science Foundation of China.

the unexpected and unfavorable weather conditions during the 1994 collecting trip influenced the quantity of specimens, 19 species of 15 genera belonging to 8 families were recorded for the first time from the Daba Mountain areas. Among them, 3 new species, *Lachnellula dabaensis, Psilopezia dabaensis,* and *Rutstroemia dabaensis,* and 2 new Chinese records, *Jafnea semitosta* and *Lachnum pudibundum,* were found. This result together with those from investigations of Shennongjia in Hubei Province (Zhuang, 1989) and the Qinlin Mountain areas in Shaanxi and Gansu provinces (Zhuang, 1996) makes for a better understanding of discomycete composition in a large region, the Qinling-Daba Mountains. Discomycetes in the Daba Mountains are listed as follows.

PEZIZALES

Helvella crispa (Scop.: Fr.) Fr., Syst. Mycol. 2(1): 14, 1822.

Specimens examined: on the ground, Wuxi, Sichuan, alt. 1800 m, X.Q.Zhang 1903, HMAS 69619; on duff, Wuxi, Sichuan, alt. 1500 m, J.Y.Zhuang 5357, VIII.9.1994, HMAS 69620; on the ground, Daba Mountain, Sichuan, Y.N.Yu & Y.S.Xing 1274, IX.3.1958, HMAS 27678.

Helvella near **leucopus** Pers., Mycol. Eur. 1:213, 1822.

Specimen examined: on the ground, Wuxi, Sichuan, L.Guo 1332, VIII.9.1994, HMAS 69622.

Notes: The ascospores of this collection are larger than typical (23-26.6 x 13.5-16.5 µm vs. 21-21.9-24 x 13-14.4-15 µm) and stipes are not as robust and course as the typical (Dissing, 1966). The spore size is very similar to that of a Shaanxi collection (HMAS 69596). They both might represent an undescribed taxon.

Jafnea semitosta (Berk. & Curt.) Korf, Nagaoa 7: 5, 1960.

Diagnostic features: Apothecia deeply cupulate, up to 1 cm in diam when dry, hymenium dark brown when dry; ectal excipulum of textura angularis, cell walls somewhat purplish brown; medullary excipulum of textura intricata, hyphae 2.5-4µm wide; asci 8-spored, J- in Melzer's reagent; ascospores subfusoid, uniguttulate, with fine warts on surface, markings 0.3-0.5 µm in diam and a few up to 1 um, 21-27 x 9-11 µm; paraphyses subcylindrical, 2-4 µm wide.

Specimen examined: on wood of a broadleaf tree, Zhenping, Shaanxi, alt.1300 m, X.Q.Zhang 1981, VIII.14.1994, HMAS 69623.

Notes: This species is a new record for China. The genus *Jafnea* Korf contains only two species (Korf, 1973). *Jafnea fusicarpa* (Ger.) Korf was previously recorded (Teng, 1963; Zhuang, 1995).

Morchella elata Fr., Syst. Mycol. 2(1): 8, 1822.

Specimen examined: on the ground, Qingchuan, Sichuan, Zheng, V.1993, HMAS 63621.

Psilopezia dabaensis W.Y. Zhuang, **sp. nov.** (fig. 1)

Ab *Psilopezia nummulariali* apotheciis 0.5-2 cm diam, ascis 4-8 sporis praeditis, ascosporis 22-29 x 13.5-17.0 µm, excipulis ectalibus ex texturis angularibus et texturis intricatibus compositis differt.

Apothecia convex, sessile, broadly attached to the substrate on a thin layer of mycelia, 0.5-2 cm in diam; hymenium dull brown when fresh and

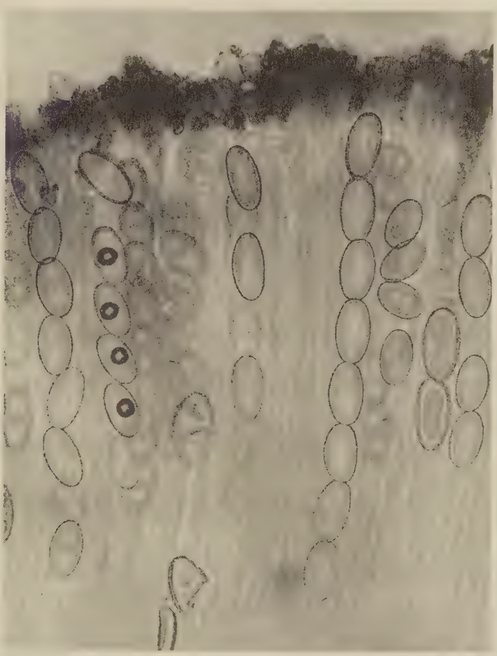

Fig. 1. *Psilopezia dabaensis:* portion of hymenium showing asci with different numbers of ascospores, x 400, from holotype.

nearly black when dry, receptacle light brown when dry; ectal excipulum of textura angularis to textura intricata, outer layer 50-75 µm thick, with club-shaped cell protrusions on surface, cells elongate at margin and isodiametric to ellipsoid below margin, 10-22 µm wide or 15-30 µm diam, inner layer refractive, 35-70 µm thick, cells elongate; medullary excipulum of textura intricata, 300-350 µm thick, hyphae hyaline, thin-walled, 7-10 µm wide, gel absent; hymenium 350-390 µm thick; asci 4-8 - spored, occasionally with only 2 spores, subcylindrical, J-, walls not blue in Melzer's reagent, 15-21 µm wide; ascospores ellipsoid, smooth-walled, uniseriate, with two large guttules, some with a De Bary bubble, 22-29(-32) x 13.5-17.0 µm, up to 34 x 16.5 µm; paraphyses slightly enlarged and encrusted with brown substances at apex, 10-15 µm wide at apex and 6.5 µm below, ca 13-20 µm exceeding asci.

Holotype: on rotten wood, Wuxi, Sichuan, alt. 1700 m, X.Q.Zhang 1953, VIII.9.1994, HMAS 69624.

Notes: In the genus *Psilopezia* Berk. (Pfister, 1975; Pfister & Candoussau, 1981) the morphology of the Wuxi fungus is similar to *Psilopezia nummularialis* Pfister & Cand. in some aspects but different from that species in structure of ectal excipulum, with 4 to 8 spores in an ascus, and wide ascospores.

Scutellinia pennsylvanica (Cooke) Denison, Mycologia 51: 619, 1961.

Specimens examined: on wet rotten wood, Wuxi, Sichuan, alt. 1900 m, X.Q.Zhang 1909, VIII.3.1994, HMAS 69625; on mossy rotten wood, Zhenping, Shaanxi, X.Q.Zhang, VIII.15.1994, HMAS 69626.

Scutellinia subhirtella Svrcek, Ceska Mykol. 25: 85, 1971.

Specimens examined: on wood, Wuxi, Sichuan, alt. 1800 m, X.Q.Zhang 1954, VIII.9.1994, HMAS 69627; on rotten wood, Wuxi, Sichuan, alt. 1800 m, X.Q.Zhang 1957, VIII.9.1994, HMAS 69628.

Tarzetta cupularis (L.: Fr.) Lambotte, Fl. Mycol. Belge, Suppl. 1: 325, 1887.

Diagnostic features: Apothecia deeply cupulate, up to 2.5 cm in diam, hymenium dirty white to beige, receptacle pustulate; ectal excipulum of textura angularis to textura globulosa, 90-115 µm thick, cells 10-35 µm in diam, loosely interconnected, walls thin and hyaline; Hymenium ca. 254 µm thick; asci 13-15 µm wide; ascospores biguttulate, 17.5-20.5 x 10.6-12.0 µm.

Specimen examined: on the ground, Wuxi, Sichuan, alt. 1800 m, X.Q.Zhang 1950, VIII.9.1994, HMAS 69629.

Notes: The ascospores are somewhat narrower than typical (Dennis, 1978). This species was formerly recorded in China as *Geopyxis cupularis* (L.) Sacc. (Tai, 1979).

Tuber californicum Harkn., Proc. Calif. Acad. Sci. 3(1): 274, 1899.

Specimen examined: Qingchuan, Sichuan, B.C.Zhang 606, IX.17.1989, HMAS 60217.

HELOTIALES

Chlorociboria aeruginascens (Nyl.) Kanouse, in Ramamurthi, Korf & Batra, Mycologia 49: 858, 1958.

Specimen examined: on wood, Daba Mountain, Sichuan, Y.N.Yu & Y.S.Xing 1678, IX.15.1958, HMAS 27636.

Ciboria peckiana (Cooke) Korf, Phytologia 21: 203, 1971.

Specimen examined: on rotten wood, Wuxi, Sichuan, X.Q.Zhang 1911, VIII.3.1994, HMAS 68514.

Crocicreas cyathoideum (Bull.) S. E. Carp., Brittonia 32: 269, 1980.

Specimen examined: on ?herbaceous stem, Wuxi, Sichuan, alt. 1900 m, X.Q.Zhang 1905, VIII.3.1994, HMAS 69630.

Notes: Ascospores of this collection are wider than typical (Carpenter, 1981).

Lachnellula dabaensis W.Y. Zhuang, **sp. nov.** (fig. 2)

Ab *Lachnellula subtilissima* ascosporis 11.5-15.3(-17.8) x 2.5-3.0 µm, uniseptatis, ascis 59-75 x 5.3-7.1 µm, paraphysibus deformis apicaliter, apotheciis 0.6-1.3 mm diam differt.

Apothecia discoid, short-stipitiate to subsessile, up to 1.3 mm in diam when rehydrated, hymenium yellow when dry, receptacle white and hairy when dry; hairs cylindrical, septate, thick-walled, 3-4 µm wide and 27-150 µm long, walls subhyaline to pale yellow, somewhat glassy, ca 1 µm thick, surface granulate, granules larger and denser at the upper portion of hairs, some with very few granules on basal cell surface; ectal excipulum of textura prismatica, 35-50 µm thick at flanks, cells mostly 7-16 x 4-7 µm, walls subhyaline and refractive; medullary excipulum of textura intricata, 40-60 µm thick, hyphae 2 µm wide, walls subhyaline; asci 8-spored, J+, pore walls blue in Melzer's reagent, 59-75 x 5.3-7.1 µm; ascospores fusoid, 1-septate, irregularly biseriate, gutttulate, 11.5-15.3(-17.8) x 2.5-3.0 µm; paraphyses deformed and sometimes branched at apex, septate, 2-2.7 µm wide.

Holotype: on a twig, Wuxi, Sichuan, alt. 1600 m, J.Y.Zhuang 5366, VIII.11.1994, HMAS 69631.

Notes: When Dharne (1965) studied the genus *Lachnellula* P. Karst. sixteen species were accepted. Since then, fourteen taxa were added to the genus according to the records in Index of Fungi (1963-1995). The genus contains about thirty species for the time being. After comparing the Daba material with the above taxa, *Lachnellula subtilissima* (Cooke) Dennis turns out to be the closest species. *Lachnellula dabaensis* differs from *Lachnellula subtilissima* (Dharne, 1965) in the larger and 1-septate ascospores, longer asci, apically deformed paraphyses and smaller apothecia.

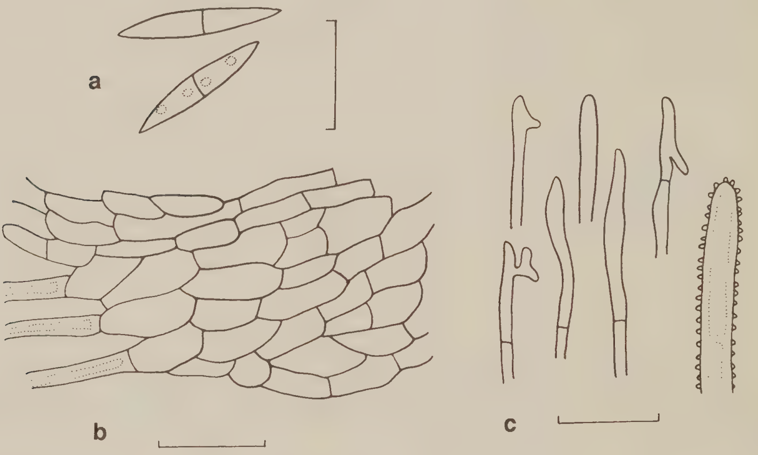

Fig. 2. *Lachenllula dabaensis:* **a.** two ascospores, scale = 10 µm; **b.** structure of ectal excipulum, scale = 15 µm; **c.** paraphysis apices and a hair apex, scale = 15 µm; all from hologype.

Lachnum abnormis (Mont.) J. H. Haines & Dumont, Mycotaxon 19: 10, 1984.

Specimens examined: on rotten wood, Wuxi, Sichuan, alt 1800 m, X.Q.Zhang 1904, VIII.3.1994, HMAS 69632; on decorticated rotten wood, Pingli, Shaanxi, alt. 2000 m, H.A.Wen, VIII.20.1994, HMAS 69633.

Notes: The ascospores of these two collections [53-74(-80) x 2.0-2.8 µm] are wider than typical (Hanies & Dumont, 1984). The paraphyses of the Wuxi collection have a cap at the apices.

Lachnum pudibundum (Quel.) J. Schroet., Krypt.-fl. 3(2): 91, 1893.

Diagnostic features: Apothecia discoid, 0.5-1.2 mm diam, hymenium whitish when fresh, vinaceous brown when dry, stipe equal to or up to 1.5 times of the disc diam; hairs granulate, pale yellow, swollen at apex, 38-81 µm long, 3.5-6.5 µm wide at apex and 3.0 µm wide below, with 1-3 septa, and as short cell protrusions at the apothecial base, less than 12 µm long; ectal excipulum of textura prismatica, 15-25 µm thick, cells 8-15 x 3-7 µm, walls subhyaline; medullary excipulum of textura intricata, 12-90 µm thick, hyphae subhyaline; asci 8-spored, J+ in Melzer's reagent, 43-48 x 4.4-4.7 µm; ascospores long ellipsoid, uniseriate to irregularly biseriate, 7-9 x 1.8-2.2 µm; paraphyses lanceolate, 3.5-5.0 µm wide, ca 20-30 µm exceeding asci.

Specimen examined: on herbaceous stem, Wuxi, Sichuan, X.Q.Zhang 1910, VIII.3.1994, HMAS 69636.

Notes: This fungus is a new record of China. It fits well Dennis (1949) description, especially the hymenium color when dry is reddish brown to somewhat vinaceous, which distinguishes this species from *Lachnum virgineum* (Batsch : Fr.) P. Karst.

Lachnum cf. **sclerotii** (A.L.Sm.) J. H. Hanies & Dumont, Mycotaxon 19: 17, 1984.

Specimens examined: on twig, Zhenping, Shaanxi, alt. 1400 m, J.Y.Zhuang 5389, VIII.15.1994, HMAS 69634; on twig, Zhenping, Shaanxi, alt. 1500 m, X.Q.Zhang 1982, VIII.15.1994, HMAS 69635.

Notes: The above collections are different from typical material (Haines & Dumont, 1984) in 1-septate instead of 3-septate ascospores. A record of *Lachnum* cf. *sclerotii* from Shennongjia, Hubei Province (Zhuang, 1989) was a different fungus from Shaanxi collection.

Lanzia microserotina W. Y. Zhuang, Mycosystema 8: (in press).

Specimen examined: on petiole, Wuxi, Sichuan, 1900 m, X.Q.Zhang 1908, VIII.3.1994, HMAS 69637.

Orbilia xanthostigma (Fr.) Fr., Summa Veg. Scand., sect. post., p.357, 1849 (sansu Svrcek, 1954).

Diagnostic features: Apothecia flat, sessile, very thin, semitransluscent, 1-3 mm in diam, cream white; asci J- in Melzer's reagent, 27-32 x 3.7-4 µm; ascoscpores ellipsoid to rod-shaped, irregularly uniseriate, 3.5-4.5 x 1.2-1.5 µm; paraphyses somewhat narrow at apex, 2-3 µm wide.

Specimens examined: on rotten wood, Wuxi, Sichuan, alt. 1800 m, X.Q.Zhang 1906, 1907, VIII.3.1994, HMAS 69638, 69639.

Rutstroemia dabaensis W.Y. Zhuang, **sp. nov.** (fig. 3)

Ab *Poculo subcinnabario* ascosporis 5.0-5.8 x 2.5-3.5 µm, ascis longis, exicipulis ectalibus ex texturis prismaticis compositis, excipulis medullaribus crassis, apotheciis aurantiacis majusculis differt.

Apothecia discoid, stipitate, 1-4.5 mm in diam, hymenium orange, recetacle concolorous, surface smooth, stipe about half of the disc diam in length, dark at very base in some collections; ectal excipulum of textura prismatica (to textura intricata), 38-50 µm thick, cells 7-13(-20) x 3-7(-10) µm, walls highly refractive, hyaline, gelatinized and thickened; medullary excipulum of textura intricata, 100-350 µm thick, hyphae 2-4 µm wide, walls slightly refractive, hyaline and thin; subhymenium not clearly distinguished; hymenium 83-90 µm thick; asci clavate, 8-spored, J+, pore walls blue in Melzer's reagent, 71-85 x 5.0-6.5 µm; ascospores ellipsoid, hyaline, uniseriate, with two small polar guttules, 5-8 x 2.5-3.5 µm; paraphyses filiform, 1.5(-2) µm wide.

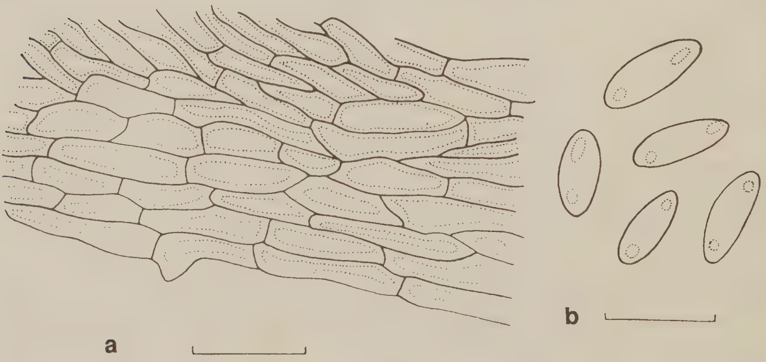

Fig. 3. *Rutstroemia dabaensis:* **a.** structure of ectal excipulum, scale = 15 µm, from HMAS 69643; **b.** ascospores, scale = 8 µm, from HMAS 69645.

Holotype: on stromatized wood, Wuxi, Sichuan, alt. 1800 m, X.Q.Zhang 1912, VIII.3.1994, HMAS 69640.

Paratypes: on wood, Wuxi, Sichuan, alt. 1800 m, X.Q.Zhang 1902, VIII.3.1994, HMAS 69641; on wood, Wuxi, Sichuan, alt. 1600 m, X.Q.Zhang 1952, VIII.9.1994, HMAS 69642; on mossy rotten wood, Wuxi, Sichuan, alt. 1800 m, X.Q.Zhang 1955, VIII.9.1994, HMAS 69643; on wood, Wuxi, Sichuan, alt. 1600 m, L.Guo 1330, VIII.9.1994, HMAS 69644; on wood, Wuxi, Sichuan, alt. 1600 m, L.Guo 1331, VIII.9.1994, HMAS 69645.

Notes: This fungus is similar to *Poculum subcinnabarium* (Dennis) Dumont (1975) but different from the latter in wider, shorter and ellipsoid ascospores, longer asci, ectal excipulum of textura prismatica, much thicker medullary excipulum, and larger apothecia.

ACKNOWLEDGEMENTS

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Teng, S.C. 1963. *Fungi of China.* Beijing.

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Zhuang, W.-y. 1995. Some new species and new records of discomycetes in China. V. *Mycotaxon* **56**: 31-40.

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FUNGAL FLORA OF THE DABA MOUNTAINS: IMPERFECT FUNGI[1]

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Eighty-two species of imperfect fungi collected from the Daba Mountains are reported, including fifty species of hyphomycetes and thirty-two species of coelomycetes. Of these, two are new species *Mycovellosiella philadelphi* Guo, sp. nov. on *Philadelphus incanus* Koeh (Saxifragaceae), *Pseudocercospora artemisiicola* Guo, sp. nov. on *Artemisia indica* Willd. (Compositae), and ten are new records for China Latin diagnoses, descriptions and illustrations of the new species and brief descriptions of the new records are provided. Specimens examined are deposited in HMAS.

Alternaria alternata (Fr.) Keissler
Beih. Bot. Zbl. 29:434, 1912.
Torula alternata Fr., Syst. Mycol. 3:500, 1832.

On *Ligularia* sp. (Compositae), Zhenping, Shaanxi Province, 18 VIII 1994, coll. Guo YL, no.DB163 (HMAS 71370).

Alternaria brassicae (Berk.) Sacc.
Michelia 2:129, 1880.
Macrosporium brassicae Berk., in Smith's Engl. Fl. 5, pt. 2:339, 1836.

On *Brassica pekinensis* Rupr. (Cruciferae), Zhenping, Shaanxi Province, 15 VIII 1994, coll. Guo YL, no.DB154 (HMAS 71371).

Ascochyta cucumeris Fautr. & Roum.
Rev. Mycol. 13:79, 1891.

On *Cucumis sativus* (Cucurbitaceae), Zhenping, Shaanxi Province, 16 VIII 1994, coll. Guo YL, no. DB160 (HMAS 71372).

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Ascochyta phaseolorum Sacc.
Michelia 1:169, 1879.

On *Dolichos lablab* L. (Leguminosae), Wuxi, Sichuan Province, 2 VIII 1994, coll. Guo YL, no.DB019 (HMAS 71375).

On *Phaseolus vulgaris* L., Wuxi, Sichuan Province, 2 VIII 1994, coll Guo YL, no.DB002 (HMAS 71373), no.DB009 (HMAS 71374); Zhenping Shaanxi Province, 14 VIII 1994, coll. Guo YL, no.DB140-A (HMAS 71376).

Asteroma frondicola (Fr. ex Ficinus & Schubert) Morelet
Bull. Soc. Sci. nat. Arch. Toulon Var 34(221):15, 1978.
Depazea frondicola Fr. ex Ficinus & Schubert, Flora Gegend um Dresden 2 Cryptogmie: 311, 1823.

On *Populus davidiana* Dode (Salicaceae), Wuxi, Sichuan Province, 2 VIII 1994, coll. Guo YL, no. DB033 (HMAS 71377).

Cercospora bidentis Tharp
Mycologia 9:108, 1917.

On *Bidens biternata* (Lour.) Merr. & Sherff (Compositae), Langao Shaanxi Province, 19 VIII 1994, coll. Guo YL, no.DB178 (HMAS 71378)

Cercospora cardaminae Losa Espano*
Anal. Jard. Bot. Madrid 6 (Part 1) :453, 1946.

Leaf spots circular, 1-10 mm in diam., confluent, pale olivaceous brown. Fruiting amphigenous. Conidiophores solitary or 3-12 in a fascicle pale olivaceous brown, wider at the base, straight to curved, geniculate rarely branched, spore scar distinct, 0-4 septate, 30-170 X 3-4µm. Conidia acicular to obclavate, hyaline, tip subacute, base subtruncate to truncate 35-140 X 3-4µm.

On *Cardamina* sp. (Cruciferae), Wuxi, Sichuan Province, 8 VIII 1994 coll. Guo YL, no.DB071 (HMAS 71379).

Cercospora rosicola Pass.
Just's Bot. Jahb. 3:276, 1877.

On *Rosa omeiensis* Rolfe (Rosaceae), Wuxi, Sichuan Province, 3 VIII 1994, coll. Guo YL, no.DB030 (HMAS 71380).

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* i. e. new record for China

Cercosporidium miurae (Syd. & P. Syd.) Liu & Guo
Acta Mycol. Sinica 1:98, 1982.
Cercospora miurae Syd. & P. Syd., Ann. Mycol. 11:117, 1913.

On *Cynanchum* sp. (Asclepiadaceae), Mt. Daba, Sichuan Province, 17 X 1958, coll. Xing YS, no.235 (HMAS 40631).

Cercosporidium sojinum (Hara) Liu & Guo
Acta Mycol. Sinica 1:100, 1982.
Cercospora sojina Hara, Nogyo Sekai (ToKyo) 9:28, 1915.

On *Glycine max* (L.) Merr. (Leguminosae), Chengkou, Sichuan Province, 22 VIII 1958, coll. Yu YN, Xing YS, no.1009 (HMAS 40646).

Cladosporium allii-cepae (Ranojevic) M. B. Ellis
More Dematiaceous Hyphomycetes:337, 1976.
Heterosporium allii-cepae Ranojevic, Ann. Mycol. 8:399, 1910.

On *Allium fistulosum* L. (Liliaceae), Zhenping, Shaanxi Province, 15 VIII 1994, coll. Guo YL, no.DB150 (HMAS 71381).

Cladosporium herbarum (Pers.) Link
Mag. Ges. nat. Freunde, Berlin 7:37, 1815.
Dematium herbarum Pers., Syn. Meth. Fung.:699, 1801(L.).

On *Zea mays* L. (Gramineae), Zhenping, Shaanxi Province, 14 VIII 1994, coll. Guo YL, no.DB134 (HMAS 71382).

Cladosporium tenuissium Cooke
Grevillea 6:140, 1878.

On *Acer mono* Maxim. (Aceraceae), Wuxi, Sichuan Province, 8 VIII 1994, coll. Guo YL, no.DB063 (HMAS 71383).

Colletotrichum tricyrtii Teng
Sinensia 7:778, 1936.

On *Tricyrtis latifolia* Maxim. (Liliaceae), Wuxi, Sichuan Province, 9 VIII 1994, coll. Guo YL, no.DB093-A (HMAS 71384).

Curvularia prasadii R. L. Mathur & B. L. Mathur*
Curr. Sci. 28:449, 1959.

Leaf spots irregular, 5-12 mm wide, brown, margin dark brown Conidiophores solitary or 2-7 in a fascicle, olivaceous brown, geniculate wider at the base, 20-75 X 4-5.4µm. Conidia brown, paler at the ends, 20-37 X 13-16µm.

On *Trifolium pratens* L. (Leguminosae), Wuxi, Sichuan Province, 3 VIII 1994, coll. Guo YL, no.DB023-A (HMAS 71385).

Ellis (1966) described this fungus on PDA, with conidiophores up to 500µm long, 3-8µm wide, conidia 25-40 X 12-17µm. This collection on Trifolium pratens L. has the conidiophores shorter and narrower.

Drechslera turcica (Pass.) Subram. & Jain
Curr. Sci. 35:355, 1966.
Helminthosporium turcicum Pass., Bull. Comizio Agr. Parma No.10, 1878.
Teleomorph: *Setosphaeria turcica* (Luttr.) Leonard & Suggs, Mycologia 66:295, 1974.

On *Zea mays* L. (Gramineae), Zhenping, Shaanxi Province, 15 VIII 1994, coll. Guo YL, no.DB148 (HMAS 71386).

Marssonina mali (P. Henn.) Ito
Bot. Mag. Tokyo 32:206, 1918.
Marsonia mali P. Henn., Engl. Jahb. 37:164, 1905.

On *Malus* sp. (Rosaceae), Zhenping, Shaanxi Province, 14 VIII 1994 coll. Guo YL, no.DB139 (HMAS 71387).

Mycovellosiella murina (Ell. & Kell.) Deighton
Mycol. Pap. 144:23, 1979.
Cercospora murina Ell. & Kell., Bull. Torrey Bot. Club 11:122, 1884.

On *Viola lactoflora* Nakai (Violaceae), Mt. Daba, Sichuan Province 5 IX 1958, coll. Xing YS, no.38 (HMAS 51945).

Mycovellosiella philadelphi Guo, sp. nov. Fig.1

Maculae amphigenae, orbiculares vel angulatae, 0.5-1 mm latae confluentae, griseo-albae. Caespituli hypogeni, effusi. Mycelium immersum et superficiale. Mycelium secundarium superficiale: hyphae pallide olivaceae, ramosae, septatae, 2-4 µm latae. Conidiophora 3-5 in fasciculis vel ex hyphis myceli secundarii oriunda, olivacea vel pallide olivaceo-brunneae, ramosa, geniculata, erecta vel leviter curvata, 0-2 septata, 4-40 X 3-6µm. Cicatrices conspicuae, 1-1.5µm latae. Conidia obclavata vel cylindrica, subhyalina vel pallide olivacea, catenata, erecta vel leviter curvata, 0-3 septata, 17-85 X 3-6µm.

Hab. in foliis vivis *Philadelphi incani* Koeh. (Saxifragaceae), Wuxi Sichuan Provincia, 8 VIII 1994, leg. Guo YL, no.DB069 (HMAS 71388 Paratypus), no.DB070 (HMAS 71389, Holotypus).

Leaf spots amphigenous, circular to angular, 0.5-1 mm wide, often several spots confluent and forming a large subcircular spot, up to 10 mm in diam., center greyish white, margin surrounded by a dark brown line

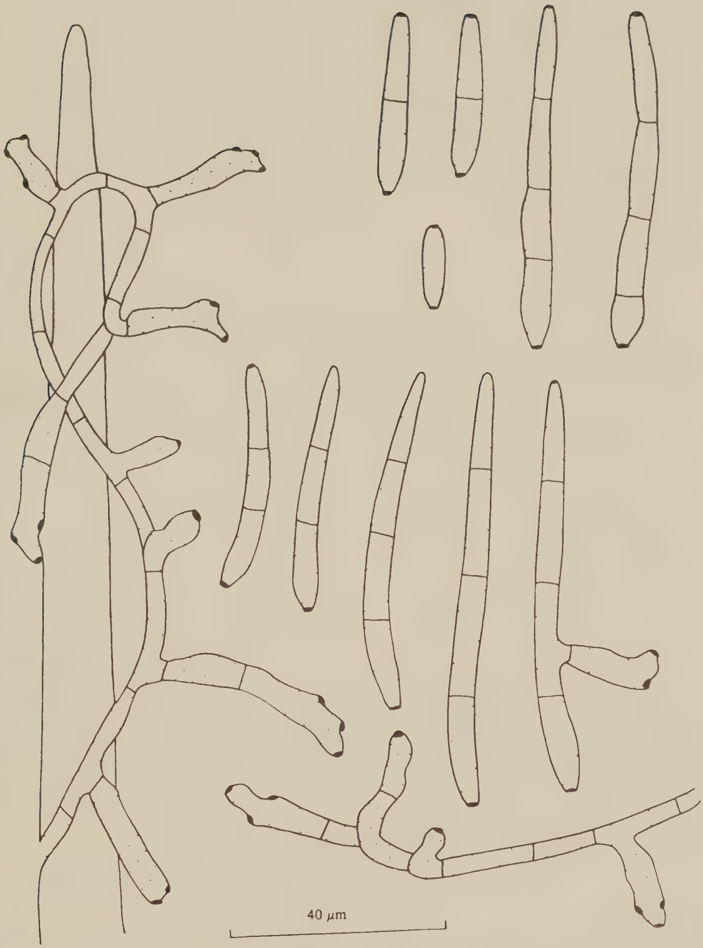

Fig. 1 *Mycovellosiella philadelphi* Guo, sp. nov.

with pale yellowish halo on the upper surface, pale greyish brown on the lower surface.

Fruiting hypogenous, effuse. Mycelium immersed and external Secondary mycelium external: hyphae emerging from the stomata, pale olivaceous, branched, septate, often climbing over the leaf hairs, 2-4µm wide. Conidiophores 3-5 emerging through stomata or arising terminally and as lateral branches from the secondary mycelial hyphae, olivaceous to pale olivaceous brown, paler and wider towards the apex, branched geniculate, straight or slightly curved, 0-2 septate, 4-40 X 3-6µm.
Conidial scars conspicuously thickened, 1-1.5µm wide. Conidia obclavate to cylindrical, subhyaline to pale olivaceous, catenate, straight or slightly curved, tip obtuse to conic, base obconic, 0-3 septate, sometimes constricted, 17-85 X 3-6µm.

On *Philadelphus incanus* Koeh. (Saxifragaceae), Wuxi, Sichuan Province, 8 VIII 1994, coll. Guo YL, no.DB069 (HMAS 71388, Paratype) no.DB070 (HMAS 71389, Holotype).

Mycovellosiella hyalofilispora (Yen) Yen on *Hydrangea macrophylla* (Thunb.) Seringe（Saxifragaceae) differs from this species by its filiform never catenate, longer and narrower conidia (28-123 X 1-1.5µm).

Mycovellosiella salicis Deighton, Verma & Prasad*
Mycol. Pap. 137:61, 1974.

Leaf spots irregular, dark brown. Fruiting hypogenous. Mycelium immersed and external. Secondary mycelium external: hyphae pale olivaceous, septate, branched, 2-2.5µm wide. Conidiophores arising terminally and as lateral branches from the secondary mycelial hyphae olivaceous, irregular in width, straight or curved, geniculate, 0-2 septate, 4-35 X 3-4.5µm. Conidial scars conspicuously thickened. Conidia subhyaline narrowly obclavate to cylindrical, catenate, straight or slightly curved septate indistinct, 15-75 X 2-4µm.

On *Salix* sp. (Salicaceae), Zhenping, Shaanxi Province, 14 VIII 1994 coll. Guo YL, no.DB114 (HMAS 71390).

Oidium sp.

On *Alchornea davidii* Franch. (Euphorbiaceae), Mt. Daba, Sichuan Province, 1 XI 1958, coll. Xing YS, no.430 (HMAS 41933).

On *Artemisia tangutica* Pamp. (Compositae), Mt. Daba, Sichuan Province, 26 X 1958, coll. Xing YS, no.366 (HMAS 41946).

On *Benincasa hispida* Cogn. (Cucurbitaceae), Chengkou, Sichuan Province, 26 VIII 1958, coll. Yu YN, Xing YS, no.1098 (HMAS 41959).

On *Bidens pilosa* L. (Compositae), Mt. Daba, Sichuan Province, 10 IX 1958, coll. YU YN, Xing YS, no.1582 (HMAS 41964).

On *Brassica* sp. (Cruciferae), Mt. Daba, Sichuan Province, 13 IX 1958, coll. Yu YN, Xing YS, no.1621 (HMAS 41969).

On *Cucurbita moschata* (Duch.) Duch. (Cucurbitaceae), Chengkou Sichuan Province, 25 VIII 1958, coll. Yu YN, Xing YS, no.1068 (HMAS 41993).

On *Ligularia* sp. (Compositae), Mt. Daba, Sichuan Province, 6 XI 1958, coll. Yu YN, Xing YS, no.1515 (HMAS 42055).

On *Robinia* sp. (Leguminosae), Mt. Daba, Sichuan Province, 5 X 1958, coll. Xing YS, no.38 (HMAS 42116).

Ovularia bulbigera (Fuckel) Sacc.
Syll. Fung. 4:140, 1886.
Scolicotrichum bulbigerum Fuckel, Symb. Mycol. 1869.

On *Sanguisorba officinalis* L. (Rosaceae), Wuxi, Sichuan Province, 4 VIII 1994, coll. Guo YL, no.DB048 (HMAS 71391).

Ovularia obliqua (Cooke) Oud.
Hedwigia p.81, 1893; Saccardo, Syll. Fung. 4:145, 1886.
Pernospora obliqua Cooke, Symb. p.103, 1865.

On *Rumex* sp. (Polygonaceae), Wuxi, Sichuan Province, 4 VIII 1994 coll. Guo YL, no.DB045 (HMAS 71392).

Phaeoisariopsis griseola (Sacc.) Ferraris
Ann. Mycol. 7:280, 1909.
Isariopsis griseola Sacc., Michelia 1:173, 1879.

On *Phaseolus vulgaris* L. (Leguminosae), Zhenping, Shaanxi Province 14 VIII 1994, coll. Guo YL, no.DB140-B (HMAS 71393), no.DB141 (HMAS 71394), 15 VIII 1994, coll. Guo YL, no.DB151 (HMAS 71395) no.DB152 (HMAS 71396).

Phaeoramularia montana (Speg.) Guo
Fungi and Lichens of Shennongjia:362, 1989.
Ramularia montana Speg., Michelia 2:169, 1880.

On *Chamaenerion angustifolium* (L.) Scop. (Onagraceae), Zhenping Shaanxi Province, 18 VIII 19994, coll. Guo YL, no.DB164 (HMAS 71397).

Phaeoramularia pruni Guo & Liu
Acta Mycol. Sinica 6:226, 1987.

On *Prunus buergeriana* Miq. (Rosaceae), Wuxi, Sichuan Province, 8 VIII 1994, coll. ichuan Province, 2 VIII 1994, coll. Guo YL, no.DB008 (HMAS 71399).

Phyllosticta glycines Thum.
Contr. Fl. Mycol. Lusit; Saccardo, Syll. Fung. 3:11, 1884.

On *Glycine max* (L.) Merr. (Leguminosae), Zhenping, Shaanxi Province, 15 VIII 1994, coll. Guo YL, no.DB153 (HMAS 71400).

Phyllosticta phaseolina Sacc.
Michelia 1:149, 1879.

On *Phaseolus* sp. (Leguminosae), Zhenping, Shaanxi Province, 14 VIII 1994, coll. Guo YL, no.DB135 (HMAS 71401).

Phyllosticta pirina Sacc.
Michelia 1:134, 1879.

On *Pyrus* sp. (Rosaceae), Zhenping, Shaanxi Province, 14 VIII 1994 coll. Guo YL, no.DB142 (HMAS 71402).

Phyllosticta quercus Sacc. & Speg.
Michelia 1:138, 1879.

On *Quercus fargesii* Fr. (Fagaceae), Wuxi, Sichuan Province, 8 VIII 1994, coll. Guo YL, no.DB059 (HMAS 71403).

Pseudocercospora aleuritidis (Miyake) Deighton
Mycol. Pap. 140:138, 1976.
Cercospora aleuritidis Miyake, Bot. Mag. Tokyo 26:66, 1912.
Teleomorph: *Mycosphaerella aleuritidis* Ou, Sinensia 11:175, 1940

On *Vernicia fordii* (Hemsl.) Airy Shaus (Euphorbiaceae), Wuxi Sichuan Province, 2 VIII 1994, coll. Guo YL, no.DB001 (HMAS 71404) Langao, Shaanxi Province, 19 VIII 1994, coll. Guo YL, no.DB187 (HMAS 71405).

Pseudocercospora artemisiicola Guo, sp. nov. Fig.2

Maculae imprimis epigenae, irregulares, 5-15 mm latae, atro-brunneae Caespituli imprimis epigeni. Mycelium immersum. Stromata nulla vel parva Conidiophora fasciculata, pallide olivaceo-brunnea, erecta vel curvata geniculata, non ramosa, 0-7 septata, interdum constricta, 15-160 X 4-6µm

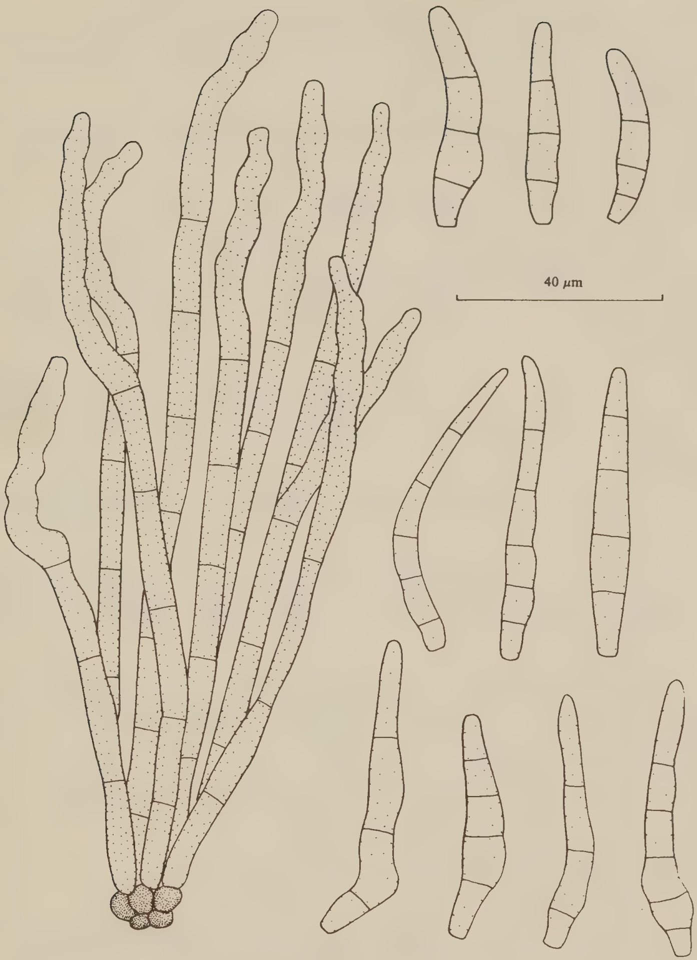

Fig. 2 *Pseudocercospora artemisiicola* Guo, sp. nov.

Conidia cylindrica vel obclavato-cylindrica, pallide olivacea vel olivacea erecta vel curvata, ad apicem rotundata vel obtusa, ad basim obconico-truncata, 1-5 septata, interdum constricta, 30-60 X 4-8.6µm.

Hab. in foliis vivis *Artemisiae indicae* Willd. (Compositae), Langao Shaanxi Provincia, 19 VIII 1994, leg. Guo YL, no.DB172 (HMAS 71406 Holotypus).

Leaf spots chiefly epiphyllous, often occurring along the tip and margin of leaf, irregular, margin indefinite, 5-15 mm wide, moderately yellowish brown, to dark brown on the upper surface, indistinct or very pale yellowish brown on the lower surface.

Fruiting chiefly epigenous. Mycelium immersed. Stromata none or small. Conidiophores fasciculate, pale olivaceous brown, uniform in color and width, straight to curved, geniculate, not branched, rounded to truncate at the apex, 0-7 septate, sometimes constricted, 15-160 X 4-6µm Conidia cylindrical to obclavate-cylindrical, shorter ones obclavate, pale olivaceous to olivaceous, straight to curved, obtuse to blunt at the apex obconically truncate at the base, 1-5 septate, sometimes constricted, 30-60 X 4-8.6µm.

On *Artemisia indica* Willd. (Compositae), Langao, Shaanxi Province 19 VIII 1994, coll. Guo YL, no.DB172 (HMAS 71406, Holotype).

Pseudocercospora dracunculi (Sarwar) Guo on *Artemisia subdigitata* differs from this species in having secondary mycelium, shorter and narrower conidiophores (4-22 X 3-4µm), and subhyaline, narrower conidia (2.5-3.7µm).

Mycovellosiella ferruginea (Fuck.) Deighton on *Artemisia* spp. is similar to this fungus. But the former possesses hypogenous, effuse fruiting conspicuously thickened spore scar, deeper color (moderately dark brown) longer conidiophores (up to 400µm long), and pale brown, rarely catenate longer and wider conidia (15-102 X 4-10µm), with an obconic base.

Pseudocercospora atromarginalis (Atk.) Deighton
Mycol. Pap. 140:139, 1976.
Cercospora atromarginalis Atk., J. Elisha Mitchell Sci. Soc. 8:59, 1892.

On *Solanum nigrum* L. (Solanaceae), Langao, Shaanxi Province, 19 VIII 1994, coll. Guo YL, no.DB174 (HMAS 71407).

Pseudocercospora buddleiae (Yamam.) Gon & Hsieh

Trans. Mycol. Soc. R.O.C. 2:114, 1987.
Cercospora buddleiae Yamam., Trans. Nat. Hist. Soc. Formosa 26:279 1936.

On *Buddleia davidii* Fr. (Loganiaceae), Mt. Daba, Sichuan Province 2 X 1958, coll. Xing YS, no.23 (HMAS 55816).

Pseudocercospora coriariae (Chupp) Liu & Guo
Mycosystema 2:232, 1989.
Cercospora coriariae Chupp, J. Dept. Agr. P. Rico 14:285, 1930.
On *Coriaria sinica* Maxim. (Coriariaceae), Mt. Daba, Sichuan Province, 1958, coll. Xing YS, no.441b (HMAS 55860).

Pseudocercospora heteromalla (Syd.) Deighton
Trans. Br. Mycol. Soc. 88:388, 1987.
Cercospora heteromalla Syd., Ann. Mycol. 22:433, 1924.
On *Rubus* sp. (Rosaceae), Mt. Daba, Sichuan Province, 10 IX 1958, coll Yu YN, no.1609 (HMAS 59044).

Pseudocercospora humuli (S. Hori) Guo & Liu
Acta Mycol. Sinica Suppl. 1:345, 1986.
Cercospora humuli S. Hori, J. Botany (London) 61:135, 1923.
On *Humulus scandens* (Lour.) Merr. (Moraceae), Langao, Shaanxi Province, coll. Guo YL, no.DB177 (HMAS 71408).

Pseudocercospora nandinae (Nagat.) Liu & Guo
Acta Mycol. Sinica 11:297, 1992.
Cercospora nandinae Nagat., Materials for Education, Kyoto Pref. No.3 1932.
On *Berberis* sp. (Berberidaceae), Wuxi, Sichuan Province, 3 VIII 1994, coll. Guo YL, no.DB031 (HMAS 71409).

Pseudocercospora paederiae [Sawada ex] Goh & Hsieh
Cercospora and Similar Fungi from Taiwan:291, 1990.
Cercospora paederiae Saw., Rep. Govt. Res. Inst. Formosa 87:84, 1944 nom. inval. (sine descriptione latina).

Pseudocercospora paulowniae Goh & Hsieh
Cercospora and Similar Fungi from Taiwan:307, 1990.
On *Paulownia* sp. (Scrophulariaceae), Langao, Shaanxi Province, 19 VIII 1994, coll. Guo YL, no.DB171-B (HMAS 71410).

On *Paederia scandens* (Lour.) Merr. (Rubiaceae), Wuxi, Sichuan Province, 8 VIII 1994, coll. Guo YL, no.DB056 (HMAS 71411).

Pseudocercospora puerariicola (Yamam.) Deighton
Mycol. Pap. 140:151, 1976.
Cercospora puerariicola Yamam., Trans. Sapporo Nat. Hist. Soc. 13:142 1934.
Teleomorph: *Mycosphaerella pueraricola* Weimer & Luttr. Phytopathology 38:350, 1948.

On *Pueraria lobata* (Willd.) Ohwi (Leguminosae), Langao, Shaanxi Province, 19 VIII 1994, coll. Guo YL, no.DB176 (HMAS 71412).

Pseudocercospora rhoidis Guo & Liu
Acta Mycol. Sinica Suppl. 1:346, 1986.

On *Rhus hypolencus* Champ. ex Benth. (Anacardiaceae), Mt. Daba Sichuan Province, 11 X 1958, coll. Xing YS, no.170 (HMAS 55927).

Pseudocercospora rubi (Sacc.) Deighton
Mycol. Pap. 140:152, 1976.
Cercospora rubi Sacc., Nuovo Giorn. Bot. Ital. 8:188, 1876.
Teleomorph: *Mycosphaerella confusa* Wolf, Mycologia 28:45, 1936.

On *Rubus corchorifolius* L. f. (Rosaceae), Zhenping, Shaanxi Province, 14 VIII 1994, coll. Guo YL, no.DB121 (HMAS 71415).

On *Rubus lambertianus* Ser. var. *grabre* Hemsl., Wuxi, Sichuan Province, 8 VIII 1994, coll. Guo YL, no.DB054 (HMAS 71416); Langao Shaanxi Province, 19 VIII 1994, coll. Guo YL, no.DB175 (HMAS 71417).

On *Rubus* sp., Mt. Daba, Sichuan Province, 29 VIII 1958, coll. Yu YN, Xing YS, no.1150 (HMAS 55944), 1 XI 1958, coll. Xing YS, no.426 (HMAS 55949), 15 X 1958, coll. Xing YS, no.65 (HMAS 55948); Langao Shaanxi Province, 19 VIII 1994, coll. Guo YL, no.DB183 (HMAS 71418) no.DB184 (HMAS 71419).

Pseudocercospora squalidula (Peck) Guo & Liu
Fungi and Lichens of Shennongjia:366, 1989,
Cercospora squalidula Peck, N. Y. State Mus. Nat. Hist. Ann. Rep. 33:29 1880.

On *Clematis apiifolia* DC. (Ranunculaceae), Wuxi, Sichuan Province 8 VIII 1994, coll. Guo YL, no.DB067 (HMAS 71413); Zhenping, Shaanxi Province, 15 VIII 1994, coll. Guo YL, no.DB147 (HMAS 71414).

Pseudocercospora toonae M. D. Mehrotra & R. K. Verma
Mycol. Res. 95:1166, 1991.

Pseudocercospora toonae Guo & Liu, Acta Mycol. Sinica 12:30, 1993.

On *Toona sinensis* (Juss.) Roem. (Meliaceae), Mt. Daba, Sichuan Province, 26 X 1958, coll. Xing YS, no.377 (HMAS 59233, Holotype), 1 XI 1958, coll. Xing YS, no.431 (HMAS 59234).

Pseudocercospora vitis (Lev.) Speg.
Ann. Mus. Nac. Hist. Nat. B. Aires 20:437, 1910.
Septonema vitis Lev., Ann. Sci. Nat. Bot. Ser. III. 9:261, 1848.
Teleomorph: *Mycosphaerella personata* Higgins, Amer. J. Bot. 16:287 1929.

On *Vitis* sp. (Vitaceae), Wuxi Sichuan Province, 3 VIII 1994, coll Guo YL, no.DB032 (HMAS 71420), Chengkou, 28 VIII 1958, coll. Yu YN, Xing YS, no. 1025 (HMAS 59254).

Pseudocercosporella capsellae (Ell. & Ev.) Deighton
Mycol. Pap. 133:42, 1973.
Cylindrosporium capsellae Ell. & Ev., J. Mycol. 3:130, 1887.

On *Brassica pekinensis* Rupr. (Cruciferae), Wuxi, Sichuan Province 2 VIII 1994, coll. Guo YL, no.DB011 (HMAS 71421).

Ramularia celastri Ell. & Mat.*
Amer. Nat 1882:1003; Saccardo, Syll. Fung. 4:198, 1886.

Leaf spots circular, 1-3 mm in diam., centre white, margin purple Fruiting hypogenous. Stromata substomatal. Conidiophores densely fasciculate, hyaline, geniculate, 8.5-32 X 4-5.5µm. Conidia cylindrical hyaline, catenate, straight or slightly curved, 1-3 septate, 20-43 X 3-4µm.

On *Celastrus glaucephyllus* R. & W. var. rugosus (R. & W.) C. Y Wu (Celastraceae), Wuxi, Sichuan Province, 3 VIII 1994, coll. Guo YL no.DB028 (HMAS 71422), 4 VIII 1994, coll. Guo YL, no.DB050 (HMAS 71423).

Ramularia celastri Ell & Mat. was originally described on *Celastrus scandens*, with conidiophores 24 X 3µm, conidia 18-21 X 3µm. In this collection from China, the conidiophores and conidia are longer and wider.

Ramularia euonymi Ell. & Kell.
J. Mycol. 1:3, 1885.

On *Euonymus alata* (Thunb.) Sieb. (Celastraceae), Wuxi, Sichuan Province, 2 VIII 1994, coll. Guo YL, no.DB027 (HMAS 71424).

Ramularia picridis Faut. & Roum.
Rev. Mycol. p.10, 1892.

On *Picris* sp. (Compositae), Pingli, Shaanxi Province, 18 VIII 1994 coll. Guo YL, no.DB168 (HMAS 71425).

Ramularia plantaginis Peck
Syll. Fung. 10:561, 1892.

On *Platago asiatica* L. (Plantaginaceae), Wuxi, Sichuan Province, 8 VIII 1994, coll. Guo YL, no.DB065 (HMAS 71426).

Ramularia rebella (Bon.) Nannf.
Fung. Exs. Suec. fasc. 39-40, Schedae p.33, 1950.
Cercysporium rubellum Bon., Bot. Zeit. 19:201, 1861.

On *Rumex nepalensis* Spreng. (Polygonaceae), Wuxi. Sichuan Province, 3 VIII 1994, coll. Guo YL, no.DB022 (HMAS 71427).

Ramularia rufomaculans Peck
34 Rep. St. Mus. 46, 1881; Saccardo, Syll. Fung. 4:216, 1886.

On *Polygonum* sp. (Polygonaceae), Zhenping, Shaanxi Province, 14 VIII 1994, coll. Guo YL, no.DB137 (HMAS 71428).

Ramularia taraxaci Karst.
Hedwigia 23:7, 1884.

On *Taraxacum mongolicum* H.-M. (Compositae), Wuxi, Sichuan Province, 2 VIII 1994, coll. Guo YL, no.DB007 (HMAS 71429).

Septoria agrimoniicola A. Bond.
Mat. Myk. Obsled. Ross., Nr. 2:6, 1921.

On *Agrimonia pilosa* Ledeb. (Rosaceae), Wuxi, Sichuan Province, 2 VIII 1994, coll. Guo YL, no.DB015 (HMAS 71430).

Septoria argyrea Sacc.
Michelia 1:127, 1879.

On *Elaeagnus umbellata* Thunb. (Elaeagnaceae), Wuxi, Sichuan Province, 3 VIII 1994, coll. Guo YL, no.DB029 (HMAS 71431).

Septoria artemisiae Pass.
Fungi Parm. Sept. n. 73, in Atti Soc. Critt. Ital. 2:32, 1879.

On *Artemisia* sp. (Compositae), Wuxi, Sichuan Province, 4 VIII 1994 coll. Guo YL, no.DB043 (HMAS 71432).

Septoria cirsii Niessl.
Mahr. Cryptogamenflora 2:36, 1864.

On *Cirsium japonicum* DC. (Compositae), Wuxi, Sichuan province, 2 VIII 1994, coll. Guo YL, no.DB013 (HMAS 71433).

On *Cirsium* sp., Pingli, Shaanxi Province, 8 VIII 1994, coll. Guo YL no.DB167 (HMAS 71434).

Septoria coriariae Pass.
Fungh. Parm. n. 28; Saccardo, Syll. Fung. 3:480, 1884.

On *Coriaria sinica* Maxim. (Coriariaceae), Mt. Daba, Sichuan Province, 26 X 1958, coll. Xing YS, no.375 (HMAS 35396).

Septoria cornicola Desmaz.
Exs. n.342; Saccardo, Syll. Fung. 3:492, 1884.

On *Cornus* sp. (Cornaceae), Wuxi, Sichuan Province, 8 VIII 1994 coll. Guo YL, no.DB072 (HMAS 71435), no.DB074 (HMAS 71436) Zhenping, Shaanxi Province, 14 VIII 1994, coll. Guo YL, no.DB112 (HMAS 71437)), no.DB118 (HMAS 71438).

Septoria dearnessii Ell. & Ev.
J. Mycol. 151, 1889; Saccardo, Syll. Fung. 10:366, 1892.

On *Angelica* sp. (Umbelliferae), Wuxi, Sichuan Province, 4 VIII 1994 coll. Guo YL, no.DB041 (HMAS 71439).

Septoria erigerontis Peck
Ann. Rep. N. Y. St. Mus. Nat. Ver. Brun, 36, 1864.

On *Erigeron annuua* (L.) Pers. (Compositae), Wuxi, Sichuan Province, 2 VIII 1994, coll. Guo YL, no.DB005 (HMAS 71440).

Septoria fullonum Sacc.
Syll. Fung. 3:553, 1884.

On *Dipsacus japonicus* Miq. (Dipsaceae), Wuxi, Sichuan Province, 3 VIII 1994, coll. Guo YL, no.DB037 (HMAS 71441).

Septoria helianthi Ell. & Kell.
Amer. Nat. Nov. 1165; Saccardo, Syll. Fung. 16:964, 1902.

On *Helianthus annuus* L. (Compositae), Wuxi, Sichuan Province, 2 VIII 1994, coll. Guo YL, no.DB003 (HMAS 71442), no.DB018 (HMAS 71443); Zhenping, Shaanxi Province, 14 VIII 1994, coll. Guo YL no.DB132 (HMAS 71444), no.DB133 (HMAS 71445).

Septoria inconspicua B. & C.*
North Amer. Fungi n.439; Saccardo, Syll. Fung. 3:554, 1884.

Leaf spots circular, 1.5-5 mm in diam., confluent, center pale brown margin purple to dark brown. Conidiomata pycnidial, epigenous, globose separate, brown, 50-120µm in diam. Conidia filiform hyaline, curved, 30-55 X 1-2µm.

On *Plantago major* L. (Plantaginaceae), Zhenping, Shaanxi Province 14 VIII 1994, coll. Guo YL, no.DB128 (HMAS 71446).

Septoria plantagina Pass. on *Plantago lanceolata* differs from this species by its wider conidia (2.5-4µm).

Septoria jenissensis Sacc.
Michelia 2:114, 1880.

On *Clematis* sp. (Ranunculaceae), Wuxi, Sichuan Province, 8 VIII 1994, coll. Guo YL, no.DB053 (HMAS 71447).

Septoria lysimachiae (Lib.) West.
Bull. de Bruxel. 120, 1852; Saccardo, Syll. Fung. 3:533, 1884.
Ascochyta lysimachiae Lib., Pl. Crypt. Ard. 252, 1834.

On *Lysimachia* sp. (Primulaceae), Zhenping, Shaanxi Province, 14 VIII 1994, coll. Guo YL, no.DB126 (HMAS 71448).

Septoria patriniae Miura
Flora of Manchuria and East Mongolia III. Cryptogams Fungi:465, 1928.

On *Patrinia* sp. (Velerianaceae), Wuxi, Sichuan Province, 8 VIII 1994 coll. Guo YL, no.DB062 (HMAS 71449), 12 VIII 1994, coll. Guo YL no.DB102 (HMAS 71450).

Septoria polygonorum Desm.
Ann. Sci. Nat. 17:108, 1842.

On *Polygonum viviparum* L. (Polygonaceae), Wuxi, Sichuan Province 4 VIII 1994, coll. Guo YL, no.DB046 (HMAS 71451).

Septoria prenanthis Ell. & Ev.*
J. Mycol. 1889:150; Saccardo, Syll. Fung. 10:368, 1892.

Leaf spots subcircular to angular, 1-4 mm wide, confluent, dark brown Conidiomata pycnidial, amphigenous, globose, separate, brown, 50-80µm in diam. Conidia filiform, hyaline, curved, septate indistinct, 20-30 X 1-1.5µm.

On *Prenanthes tatarinousii* Maxim. (Compositae), Wuxi, Sichuan Province, 9 VIII 1994, coll. Guo YL, no.DB083 (HMAS 71452).

Septoria pteridis Peck*
44 Rep. pag.24,1892; Saccardo, Syll. Fung. 10:387, 1892.

Leaf spots subcircular, 0.5-1 mm in diam., centre pale brown, margin dark brown. Conidia filiform, hyaline, very curved, up to 120µm long, 1.5-2µm wide.

On *Pteridium aquilinum* (L.) Kuhn var. *latiusculum* (Desv.) Underw (Pteridaceae), Wuxi, Sichuan Province, 2 VIII 1994, coll. Guo YL no.DB014 (HMAS 71453).

Septoria aquilina Pass. on *Pteridium aquilinum* differs from this fungus in having shorter and wider conidia (50-65 X 4µm).

Septoria rubi West.
Herb. Crypt. Belg. 938, 1854; Saccardo, Syll. Fung. 3:486, 1884.

On *Rubus nivea* Thunb. (Rosaceae), Wuxi, Sichuan Province, 2 VIII 1994, coll. Guo YL, no.DB012 (HMAS 71454).

On *Rubus* sp., Wuxi, Sichuan Province, 4 VIII 1994, coll. Guo YL no.DB052 (HMAS 71455), 8 VIII 1994, coll. Guo YL, no.DB068 (HMAS 71456), 9 VIII 1994, coll. Guo YL. no.DB082 (HMAS 71457).

Septoria salicicola (Fr.) Sacc.
Michelia 1:181, 1879.

Depazea salicicola Fr., Syst. Mycol. 2:530, 1823.

On *Salix wallichiana* Anderss. (Salicaceae), Zhenping, Shaanxi Province, 14 VIII 1994, coll. Guo YL, no.DB109 (HMAS 71458).

Septoria symploci Ell. & Mart.*
Am. Nat. 1882:1002; Saccardo, Syll. Fung. 3:494, 1884.

Leaf spots subcircular, 1-5 mm in diam., centre greyish white to pale yellowish brown, margin dark purple. Conidiomata pycnidial, epigenous globose, brown, 60-140µm in diam. Conidia acicular to filiform, hyaline very curved, 25-60 X 1.5-2.5µm.

On *Symplocos paniculata* Wall. (Symplocaceae), Wuxi, Sichuan Province, 2 VIII 1994, coll. Guo YL, no.DB020 (HMAS 71459).

Septoria symploci Ell. & Mart. was originally described on *Symplicos tinctoria*, with conidia cylindric-obclavate, hyaline, curved, 2-3 septate, 24-30 X 3µm. In this collection from China, the conidia are longer.

Septoria stigma B. & C. and *Septoria tinctoria* Dearness & House both on *Symplocos* spp. differ from this fungus by the former having shorter conidia (15µm), and the latter possessing narrower conidia (1-1.5µm).

Septoria viburni West.
Bull. Soc. de Brux. 1852, XIX, Part 3:121; Saccardo, Syll. Fung. 3:493 1884.

On *Viburnum* sp. (Caprifoliaceae), Mt. Daba, Sichuan Province, 17 IX 1958, coll. Yu YN, no.1643 (HMAS 35405).

Sirococcus spiraeae (Lebedeva) Petrak*
Sydowia 1:155, 1947.
Sirodiplospora spiraeae Lebedeva, Not. Sist. Inst. Crypt. Hort. Bot. Petrop 1:62, 1922.

On *Spiraea japonica* L. var. *fortunei* (Pl.) Rehd. (Rosaceae), Pingli Shaanxi Province, 18 VIII 1994, coll. Guo YL, no.DB166 (HMAS 71460).

Stemphylium sarciniforme (Cav.) Wiltshire
Trans. Br. Mycol. Soc. 21:224, 1938.
Macrosporium sarciniforme Cav., Def. dei parass. 1890, n. 4, c. ic Saccardo, Syll. Fung. 10:575, 1892.

On *Trifolium pratens* L. (Leguminosae), Wuxi, Sichuan Province, 3 VIII 1994, coll. Guo YL, no.DB023-B (HMAS 71461).

Tripospermum juglandis (Thum.) Hughes
Mycol. Pap. 46:15, 1951.
Triposporium juglandis Thum., Rev. Mycol. 1:59, 1879.

On *Cotoneaster acuminatus* Lindl. (Rosaceae), Wuxi, Sichuan Province, 3 VIII 1994, coll. Guo YL, no.DB036 (HMAS 71462).

On *Pterocarya hupehensis* Skan (Juglndaceae), Wuxi, Sichuan Province, 9 VIII 1994, coll. Guo YL, no.DB084 (HMAS 71463).

Tripospermum myrti (Lind) Hughes
Mycol. Pap. 46:18, 1951.
Triposporium myrti Lind, Danish Fungi:537, 1913.

On *Neillia sinensis* Oliv. (Rosaceae), Wuxi, Sichuan Province, 8 VIII 1994, coll. Guo YL, no.DB060 (HMAS 71464).

Troposporella monospora (Kendrick) M. B. Ellis*
More Dematiaceous Hyphomycetes:47, 1976.
Helicoma monospora Kendrick, Trans. Br. Mycol. Soc. 41:446, 1958.

Leaf spots subcircular, brown, 1-3 mm in diam. Mycelium superficial Conidiophores pale brown, unbranched, up to 55μm long, 4μm wide Conidia solitary, helicoid, pale brown, 3-5 septate, 9-14.5μm in diam.

On *Rhododendron* sp. (Ericaceae), Wuxi, Sichuan Province, 3 VIII 1994, coll. Guo YL, no.DB026 (HMAS 71568).

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大巴山真菌区系：半知菌

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本文报道大巴山地区半知菌24属82种：丝孢菌17属50种，腔孢菌7属32种，其中有两个新种：山梅花菌绒孢 (*Mycovellosiella philadelphi* Guo, sp. nov.), 寄生在虎耳草科 (Saxifragaceae)的山梅花 (*Philadelphus incanus* Koeh.) 叶上，蒿生假尾孢(*Pseudocercospora artemisiicola* Guo, sp. nov.)，寄生在菊科(Compositae)的印度蒿 (*Artemisia indica* Willd.)叶上，和10个中国新记录种。新种提供了拉丁文简介、描述和图，新记录种附以简短描述。研究的标本保存在中国科学院微生物研究所真菌标本室(HMAS)。

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FUNGAL FLORA OF THE DABA MOUNTAINS: MACROMYCETES [*]

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ABSTRACT: Macrofungal specimens collected from the Daba mountains have been studied , and identified. 36 species are economically important, belonging to 23 genera and 5 orders (Auriculariales, Tremellales, Agaricales, Boletales and Lycoperdales). 29 species are found to be edible, 22 species medicinal and 5 species poisonous. Materials studied are deposited in the Mycological Herbarium of the Institute of Microbiology, Academia Sinica (HMAS).

KEY WORDS: Macromycetes, Auriculariales, Tremellales, Agaricales , Boletales, Lycoperdales

摘要：作者于1994年8月参加中国科学院真菌地衣系统学开放研究实验室对中国大巴山地区真菌资源的考察采集。由于该地区严重干旱仅采集大型真菌70余号，未能反应大巴山地区丰富的大型真菌资源。本工作仅将采集到的标本进行研究鉴定，共有36种，隶属5目，23属，其中可食大型真菌29种，药用菌22种，有毒菌5种。研究标本保藏于中国科学院微生物研究所真菌标本室（HMAS）

关键词：大型真菌，木耳目，银耳目，蘑菇目，牛肝菌目，马勃目

I. Auriculariales

1. **Auricularia polytricha** (Mont.) Sacc., Misc. 1:12. 1882.
   Habitat: on deciduous wood.
   Specimens examined: Wuxi Sichuan, Wen Hua An 022, 9 Aug. 1994. HMAS 69660; X.Q. Zhang 1962, 11 Aug. 1994. HMAS 68526.
   Economic value: Edible and Medicinal.

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[*] Supported by the Special Foundation for floral and taxonomic Studies, Chinese Academy of Sciences.

II. Tremellales

2. **Tremella aurantia** Schw.: Fr., Syst. Myc. 2: 215. 1822.
   Habita:on decicuous tree.
   Specimens examined: Wuxi Sichuan, Wen Hua An 032, 9 Aug. 1994. HMAS 69671.
   Economic value : Edible and Medicinal.

III. Agaricales

3. **Amanita agglutinata** (Berk. et Curt.) Lloyd, Myc. Writings 1:9. 1898.
   Habitat: on ground in broadleaf woods.
   Specimens examined: Wuxi Sichuan , Wen Hua An 043, 10 Aug. 1994. HMAS 66306.
   Economic value: Poisonous and Medicinal.
4. **Amanita casearea** (Scop.: Fr.) Pers. ex Schw., Schr. Nat. Ges. Leipzing, 1:79. 1822.
   Habitat: on ground in broadleaf trees.
   Specimens examined: Wuxi Sichuan, Wen Hua An 042, 10 Aug. 1994. HMAS 66300.
   Economic value: Edible and Medicinal.
5. **Coprinus micaceus** (Bull. :Fr.) Fr., Epicr. p.217. 1838.
   Habitat: on deciduous wood.
   Specimens examined: Wuxi Sichuan, Wen Hua An 024, 9 Aug. 1994. HMAS 69674; Pingli Shaanxi 064, 20 Aug.1994. HMAS 69663.
   Economic value: Edible and Medicinal.
6. **Crepidotus mollis** (Schaeff.:Fr.) Gray, Nat. Arr. Brit. pl. 1:616. 1821.
   Habitat: on deciduous wood in broadleaf trees.
   Specimens examined: Wuxi Sichuan,Wen Hua An 002, 3 Aug. 1994. HMAS 69653.
   Economic value: Edible.
7. **Cystoderma amianthinum** (Scop.: Fr.) Fayod, Ann. Sc. Nat. Ser. 7, 9:351. 1889.
   Habitat: on ground in coniferous trees .
   Specimens examined: Pingli Shaanxi, Wen Hua An 057,18 Aug. 1994. HMAS 69669.
   Economic value: Edible.
8. **Inocybe fastigiata** (Schaeff. : Fr.) Quel., Champ. Jura Vosg. 1:180. 1872.
   Habitat: on ground in coniferous trees.
   Specimens examined: Wuxi Sichuan, Wen Hua An 016, 4 Aug. 1994. HMAS 69652; Pingli Shaanxi 061 , 20 Aug. 1994. HMAS 69651.
   Economic value: Poisonous and Medicinal.
9. **Inocybe rimosa** (Bull.: Fr.) Quel., Champ. Jura Vosg. 1:180. 1872.
   Habitat: on ground in broadleaf trees.

Specimens examined: Wuxi Sichuan, Wen Hua An 006, 3 Aug.1994, HMAS 66298.
Economic value: Poisonous.

10.**Lactarius piperatus** (L.: Fr.) Gray, Nat. Arr. Brit. Pl. 1:623. 1821.
Habitat: on ground in mixed trees.
Specimens examined: Wuxi Sichuan, Wen Hua An 034, 10 Aug. 1994. HMAS 68974.
Economic value: Edible and Medicinal.

11.**Lentinus edodes** (Berk.) Sing., Agaricales, p. 279. 1949.
Habitat: on broadleaf deciduous wood.
Specimens examined: Zhenping Shaanxi, Wen Hua An 049, 050, 13 Aug.1994.HMAS 66305, 68661.
Economic value: Edible and Medicinal.

12.**Lentinus lepidius** Fr. , Epicr. 390. 1838.
Habitat: on broadleaf deciduous wood.
Specimens examined: Wuxi Sichuan, Wen Hua An 048, 11 Aug. 1994 . HMAS 69661; Zhenping Shaanxi 053 ,18 Aug. 1994. HMAS 68973.
Economic value: Edible and Medicinal.

13.**Marasmius ramealis** (Bull.) Fr. , Epicr. p.381. 1838.
Habitat: on broadleaf deciduous wood.
Specimens examined: Wuxi Sichuan, Wen Hua An 005, 029 , 3 Aug. 1994. HMAS 69648, 69678.
Economic value: Medicinal.

14.**Pholiota mutabilis** (Schaeff. :Fr.) Quel., Champ. Jura Vosg. p.94. 1872.
Habitat: on deciduous wood.
Specimens examined: Wuxi Sichuan, Wen Hua An 025 , 9 Aug. 1994. HMAS 69665.
Economic value: Edible .

15.**Pholiota squarrosoides** (Pk.) Sacc., Syll. Fung. 5: 750. 1887.
Habitat: on deciduous wood.
Specimens examined: Wuxi Sichuan, Wen Hua An 028, 9 Aug. 1994. HMAS 68975.
Economic value: Edible.

16.**Pleurotus dryinus** (Pers. : Fr.) Quel., Champ. Jura Vosg. 1:111. 1872.
Habitat: on deciduous wood.
Specimens examined: Wuxi Sichuan, Wen Hua An 030, 9 Aug. 1994. HMAS 69650.
Economic value: Edible .

17.**Pleurotus ostreatus** (Jacq.: Fr.) Quel., Champ. Jura Vosg. 1:112.1872.
Habitat: on deciduous wood.
Specimens examined: Pingli Shaanxi, Wen Hua An 065, 20 Aug. 1994. HMAS 69672.

Economic value: Edible and Medicinal.

18.**Pluteus longistratus** Pk.,N.Y. State Mus. Rep. 30. 1878.
Habitat: on deciduous wood.
Specimens examined: Zhenping Shaanxi, Wen Hua An 052, 17 Aug. 1994. HMAS 6965.
Economic value: Edible.

19.**Psathyrella candolleana** (Fr.) A.H.Smith, Contr. Univ. Mich. Herb. 5:41. 1941.
Habitat: on ground in broadleaf trees.
Specimens examined: Wuxi Sichuan, Wen Hua An 008 , 3 Aug. 1994. HMAS 69655.
Economic value: Edible.

20.**Psathyrella velutina** (Pers. : Fr.) Sing., Agaricales, p.466. 1949.
Habitat: on ground in woodland paths.
Specimens examined: Zhenping Shaanxi, Wen Hua An 051,17 Aug. 1994. HMAS 66299.
Economic value: Edible.

21.**Pseudocoprinus disseminata** (Pers.: Fr.) Kuh., in Botaniste 20: 156. 1928.
Habitat: on deciduous wood.
Specimens examined: Wuxi Sichuan, Wen Hua An 001, 3 Aug. 1994. HMAS 66303.

22.**Russula delica** Fr., Epicr. p.350. 1838.
Habitat: on ground in broadleaf trees.
Specimens examined: Wuxi Sichuan, Wen Hua An 035, 10 Aug. 1994. HMAS 66302.
Economic value: Edible and Medicinal.

23.**Russula erythropus** Pelt., Bull. Soc. Myc. Fr. 24:117.1908.
Habitat: on ground in broadleaf trees.
Specimens examined: Wuxi Sichuan, Wen Hua An 038, 10 Aug. 1994. HMAS 69668.
Economic value: Edible.

24.**Russula foetens** Pers. : Fr., Epicr. p. 359. 1838.
Habitat: on ground in broadleaf trees.
Specimens examined: Wuxi Sichuan, Wen Hua An 036, 10 Aug. 1994. HMAS 66304.
Economic value: Poisonous and Medicinal.

25.**Russula lactea** (Pers. : Fr.) Fr., Epicr. p.355. 1838.
Habitat: on ground in broadleaf trees.
Specimens examined: Wuxi Sichuan , Wen Hua An 039, 10 Aug. 1994. HMAS 69670.
Economic value: Edible.

26.**Russula senecis** Imai, Jour. Facul. Agr. Hokkaido Imp. Univ. 43:334.Pl. 5.f.7. 1838.
Habitat: on ground in broadleaf trees.
Specimens examined: Wuxi Sichuan,Wen Hua An 037, 10 Aug. 1994. HMAS 66301.
Economic value: Poisonous and Medicinal.

27.**Russula virescens** (Schaeff.) Fr., Epicr. p.355. 1838.
Habitat: onground in mixed trees.
Specimens examined: Pingli Shaanxi, Wen Hua An 059, 20 Aug. 1994. HMAS 69659.
Economic value: Edible and Medicinal.

28.**Russula xerampelina** (Schaeff.ex Secr.) Fr., Epicr. p.356. 1838.
Habitat: on ground in broadleaf trees.
Specimens examined: Wuxi Sichuan , Wen Hua An 026, 9 Aug. 1994. HMAS 69656.
Economic value: Edible and Medicinal.

29.**Schizophyllum commune** Fr., Syst. Myc. 1:330. 1821.
Habitat: on deciduous woods.
Specimens examined: Langao Shaanxi, Wen Hua An 066, 19 Aug. 1994. HMAS 69677; Zhenping Shaanxi 067, 17 Aug. 1994, HMAS 66138; Wuxi Sichuan, X. Q. Zhang 1961, Aug. 1994 . HMAS 69657.
Economic value: Edible and Medicinal.

30.**Tricholomopsis platyphylla** (Pers. :Fr.) Sing., Agaricales, p. 196. 1949.
Habitat: on ground in broadleaf trees.
Specimens examined: Wuxi Sichuan, wen Hua An 020, 9 Aug. 1994. HMAS 69670.
Economic value: Edible and Medicinal.

IV. Boletales

31.**Leccinum scabrum** (Bull.:Fr.) gray, Nat. Arr. Brit. pl.1:647. 1821.
Habitat: on ground in broadleaf trees.
Specimens examined: Wuxi Sichuan, Wen Hua An 047, 10 Aug. 1994. HMAS 69675; Pingli Shaanxi 055,18 Aug. 1994. HMAS 69658.
Economic value: Edible.

32.**Pulveroboletus ravenelii** (Berk. & Curt.) Murr., Mycologia, 1:9. 1909.
Habitat: on ground in broadleaf trees.
Specimens examined: Wuxi Sichuan, Wen Hua An 045, 10 Aug. 1994. HMAS 69666.
Economic value: Edible and Medicinal.

33.**Suillus albidipes** (Pk.) Sing., Farlowia 2:45. 1945.
Habitat: on ground in coniferous trees.
Specimens examined: Pingli Shaanxi, Wen Hua An 060, 20 Aug. 1994. HMAS 69647.

Economic value: Edible.

34.**Suillus granulatus** (L. : Fr.) Kuntze, Rev. Gen. Pl. 32: 535. 1898.
Habitat: on ground in coniferous trees.
Specimens examined: Pingli Shaanxi, Wen Hua An 058, 20 Aug. 1994 . HMAS 66307.
Economic value: Edible and Medicinal.

V. Lycoperdales

35.**Calvatia caelata** (Bull. ex DC.) Morg., J. Cinci. Soc. Nat. Hist. 12: 169. 1890.
Habitat: on ground in broadleaf trees.
Specimens examined: Pingli Shaanxi, Wen Hua An 063, 20 Aug. 1994. HMAS 66137.
Economic value: Edible and Medicinal.

36. **Lycoperdon perlatum** Pers., Syn. Meth. Fung. 148. 1801.
Habitat: in woodland.
Specimens examined: Wuxi Sichuan, Wen Hua An 015, 4 Aug. 1994. HMAS 69667.
Economic value: Edible and Medicinal.

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FUNGAL FLORA OF DABA MOUNTAINS: APHYLLOPHORALES AND SOME BASIDIOMYCOTA[1]

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A checklist of fungi collected from the Daba Mountains in China is provided. This includes 30 species of 23 genera belonging to 5 families in Aphyllophorales and 2 species belonging to 2 genera in Nidulariales. All specimens studied are deposited in HMAS.

摘要 由于三十多年来未遇的大旱，作者1994年8月至9月在大巴山地区采集的非褶菌类标本很少，远不能代表该地区这类真菌的丰富资源，此次共采集标本80号，隶属非褶菌目的5科23属30种。除此之外还有鸟巢菌目的2属2个种在此一并报道。

Antridiella versicutis (Berk. & Curt.) Gilbn. & Ryv., North Am. Polyp. 1: 158, fig. 61, 1986.
Specimens examined: On dead deciduous trees. Wuxi, sichuan, alt. 1500m, X. Q. Zhang. VIII.11.1994, 1964 HMAS 69685.

Bjerkandera adusta (Willd. : Fr.) Karst., Medd. Soc. Fauna Fl. Fenn. 5: 38, 1897.
Specimens examined: On rooten wood of deciduous trees, such as Quercus. Wusi, Sichuan, alt. 1300-1800 m, X. Q. Zhang. VIII 9.1994. 1928 HMAS 68534; VIII.10.1994. 1959 HMAS 68527; Zhenping, Shaanxi, alt. 1500 m, X. Q. Zhang. VIII.15.1994. 1977 HMAS 66190.

Coltricia perennis (L. : Fr.) Murr., J. Mycol. p.91, 1903.
Specimens examined: On the ground in forests. Zhenping, Shaanxi, X. Q. Zhang et al. VIII.18.1994. 1883 HMAS 69682.

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[1] Supported by the Special Foundation for Flora and Taxonomic Studies, Chinese Academy of Sciences

Crucibulum laeve (Huds.) Kambly, in Kambly & Lee, Univ. Lowa Stud. Nat. Hist. 17(4): 167, 1936.
Specimens examined: On dead branch. Wuxi, Sichuan, alt. 1900 m, X. Q. Zhang. VIII.3.1994, 1914 HMAS 69699.

Daedalea dickinsii (Berk.) Yasuda, Bot. Mag. Tokyo 36:128, 1922.
Specimens examined: On rotten wood. Zhenping, Shaanxi, alt. 1600m, X. Q. Zhang et al. VIII.15.1994, 1978 HNAS 62479; On rotten wood of deciduous trees. alt. 1500 m, X. Q. Zhang. VIII.14.1994, 1971 HMAS 71337.

Daedaleopsis tricolor (Bull. : Fr.) Bond. et Sing., Ann. Mycol. 39: 64, 1941.
Specimens examined: On dead wood of deciduous trees. Wuxi, Sichuan, alt. 1900 m, X. Q. Zhang. VIII.9.1994, 1942 HMAS 66265.

Flabellophora licmophora (Mass.) Corner, Ad Polyporaceas IV, p.32, Fig. 3, 1987.
Specimens examined: On branch of deciduous trees. Wuxi, Sichuan, alt. 1400 m, X. Q. Zhang, VIII.9.1994, 1933 HMAS 68662.

Fomes fomentarius (L. : Fr.) Kickx subsp. fomentarius Fl. Crypt. Flandres 2: 237, 1867.
Specimens examined: On rotten wood of deciduous trees. Wuxi, Sichuan, alt. 1500-1600 m, X. Q. Zhang, VIII.9.1994, 1929 HMAS 68971; 1939 HMAS 66191; 1940 HMAS 66264; VIII.11.1994, 1965 HMAS 66188; Zhenping, Shaanxi, alt. 1600 m, VIII.15.1994, 1979 HMAS 66266; 1980 HMAS 62472.

Fomes marginatus (Pers. : Fr.) Gill., Champ. Fr. 1: 683, 1878.
Specimens examined: On rotten wood of deciduous trees. Wuxi, Sichuan, alt. 1900 m, X. Q. Zhang et al. VIII.4.1994, 1922 HMAS 66189; On deciduous trees. Wuxi, Sichuan, alt. 1600 m, VIII.11.1994, 1963 HMAS 68972.

Ganoderma applanatum (Pers.)Pat., Bull. Soc. Mycol. Fr. 5: 67, 1889.
Specimens examined: On rotten wood of deciduous trees. Wuxi Sichuan, alt. 1500-1980 m, X. Q. Zhang et al. VIII.9.1994, 1931 HMAS 62475; 1934 HMAS 71302; 1935 HMAS 7130; 1941 HMAS 68985; 1943 HMAS 66267; 1945 HMAS 66192.

Ganoderma sinense Zhao, Xu et Zhang, Acta Microbiol. Sinica 19(3): 272, Fig. 2(6), Pl. II-1, 1979.
Specimens examined: On Quercus trees. Zhenping, Shaanxi, alt. 1000 m, Jun Deng, VIII.14.1994, 1995 HMAS 68970.

Hirschioporus elongatus (Berk.) Teng, Fungi from China, p.484, 1963.
Specimens examined: On rotten wood, Wuxi Sichuan, alt. 1800m, X. Q. Zhang, VIII.9.1994, 1946 HMAS 66312; Zhenping, Shaanxi, alt. 1400 m, X. Q. Zhang, VIII.16.1994. 1987 HMAS 69680.

Inonotus radiatus (Sow. : Fr.) Karst., Krit. Ofvers. Finl. Basidsv., p.331, 1889.
Specimens examined: On rotten wood of Quercus. Wuxi, Sichuan, alt. 1300 m, X. Q. Zhang, VIII.10.1994, 1958 HMAS 69681.

Lenzites betulina Fr. : Fr. var. betulina, Epicr., p. 405, 1838.
Specimens examined: On rotten wood of deciduous trees. Wuxi Sichuan, alt. 1700 m, X. Q. Zhang et al, VIII. 9.1994, 1925 HMAS 66200; 1926 HMAS 69687.

Merulius tremellosus Schrad. : Fr., Syst. Mycol. 1:327, 1981.
Specimens examined: On rotten wood. Zhenping Shaanxi, alt. 1600 m, X. Q. Zhang, VIII.15.1994, 1983 HMAS 69692.

Microporus xanthopus (Fr.) Kunt., Rev. Gen Pl. 3: 494, 1898.
Specimens examined: On rotten trees. Wuxi Sichuan, alt. 2050 m, X. Q. Zhang, VIII.4.1994, 1884 HMAS 69697.

Nidula niveo-tomentosa (Henn.) Lloyd, Myc. Writ. 3: 455, 1910.
Specimens examined: On dead branch. Wuxi, Sichuan, alt. 1900 m, X. Q. Zhang, VIII.3.1994, 1915 HMAS 68978.

Oxydontia chrysella (Berk. et Curt.) Ito, Mycol. Fl. Jap. Vol.II (4): 189, 1955.
Specimens examined: On rotten bark. Wuxi, Sichuan, alt. 1700 m, Shuxia Wei, VIII.9.1994, 1944 HMAS 68984.

Phellinus gilvus (Schw.)Pat., Ess. Tax. Hymen., p.97, 1900.
Specimens examined: On rotten wood of deciduous trees, Zhenping, Shaanxi, alt. 1500 m, X. Q. Zhang et al, VIII.16.1994, 1986 HMAS 66202.

Polyporus arcularius Batsch : Fr., Syst. Mycol. 1: 343, 1821.
Specimens examined: On rotten wood. alt.1400 m, Zhenping Shaanxi, X. Q. Zhang et al, VIII.14.1994, 1968 HMAS 69698.

Polyporus elegans Bull. : Fr., Epicr., p.440, 1838.
Specimens examined: On dead wood of deciduous trees, such as Salis. Wuxi, Sichuan, alt. 1900 m, X. Q. Zhang, VIII.3.1994, 1913 HMAS 68529; alt 1900-2000 m, X. Q. Zhang, VIII.4.1994, 1919 HMAS 66263; 1923 HMAS 66295. Zhenping Shanxi, alt. 1400 m. X. Q. Zhang et al, VIII.14. 1994, 1969 HMAS 69700.

Polyporus spatulatus (Jungh.) Corner, Ad Polyporaceas II & III, p. 67, Fig. 12, 1984.
Specimens examined: On rotten wood of broadleaf trees. Wuxi Sichuan, alt. 1500 m, X. Q. Zhang et al. VIII.9.1994, 1938 HMAS 69693.

Polyporus tenuissimus X. Q. Zhang et Zhao, Acta Mycol. Sin. suppl. 1: 273-275, 1986.
Specimens examined: On dead trees of deciduous. Wuxi, Sichuan, alt. 1800 m, X. Q. Zhang. VIII.9.1994, 1924 HMAS 68980.

Pycnoporus cinnabarinus (Jacq. : Fr.) Karst., Rev. Mycol. 3: 18, 1881.
Specimens examined: On dead wood of deciduous trees. Zhenping Shaanxi, alt. 1400 m, X. Q. Zhang. VIII.16.1994, 1989 HMAS 68528.

Skeletocutis nivea (Jungh.) Keller, Persoonia 10: 353, 1979.
Specimens examined: On dead branch, Zhenping Shaanxi, alt. 1500 m, X. Q. Zhang et al. VIII.15.1994, 1974 HMAS 69695.

Spongipellis litschaueri Lohwag, Arch. Protistenkunde B 75(3): 301, 1931.
Specimens examined: On rotten trees. Zhenping Shaanxi, alt. 1600 m, X. Q. Zhang et al. VIII.15.1994 1975 HMAS 66308.

Steccherinum cirrhatum (Pers. : Fr.) Teng, Fungi from China, p.471, 1963.
Specimens examined: On rotten wood of deciduous trees. Wuxi Sichuan, alt 1800 m, X. Q. Zhang et al. VIII.9.1994, 1882 HMAS 69696; 1949 HMAS 66310.

Trametes gibbosa Pers. : Fr., Epicr., p.492, 1838.
Specimens examined: On rotten trees of deciduous, Wuxi Sichuan, alt. 1500-1900 m, X. Q. Zhang. VIII.4.1994, 1921 HMAS 69691; VIII. 9.1994, 1932 HMAS 66198; 1936 HMAS 68977; 1937 HMAS 66203; 1948 HMAS 66199;

Trametes hirsuta (Wulf. : Fr.) Pilat, Atl. Champ. Eur. 3: 265, 1939.
Specimens examined: On dead branch of deciduous trees, Wuxi Sichuan, alt. 2050 m, Hua-an Wen, VIII.4.1994, 1918 HMAS 66201; On rotten wood, Zhenping Shaanxi, alt 1300-1400m X.Q. Zhang et al, VIII.14. 1994, 1970 HMAS 66197; VIII.16.1994, 1984 HMAS 69689; 1985 HMAS 663; Pingli Shaanxi, alt. 2000 m, X. Q. Zhang et al, VIII.18. 1994, 1991 HMAS 69684; 1998 HMAS 68979; Langao Shaanxi, alt. l450 m, X. Q. Zhang, VIII.19.1994, 1993 HMAS 69686; Zhenping Shaanxi, lalt. 1300 m, X. Q. Zhang, VIII.17.1994. 1996 HMAS 69683.

Trametes versicolor (L. : Fr.) Pilat, Atl. Champ. Eur. 3: 261, 1936.
Specimens examined: On dead wood of deciduous trees, such as Betula, Wuxi Sichuan, alt.1500-2050 m, X. Q. Zhang et al, VIII.3.1994, 1901 HMAS 66296; VIII.4.1994, 1917 HMAS 68532; VIII.9.1994. 1927 HMAS 68535; On rotten wood of Toxicodendron, Pingli Shaanxi, alt. 2000 m, X. Q. Zhang et al, VIII.18.1994, 1992 HMAS 68987; On rotten wood, Zhenping Shaanxi, alt.1400 m, X. Q. Zhang et al, VIII.16.1994, 1997 HMAS 68536.

Trichaptum abietinum (Dicks. : Fr.) Ryv., Norw. J. Bot. 19: 237, 1972.
Specimens examined: On rotten wood, Zhenping Shaanxi, alt.1400 m, X. Q. Zhang, VIII.16.1994, 1994 HMAS 69688.

Tyromyces amygdalinus (Berk. & Rav.) Teng, Fungi from China, p.520, 1963.
Specimens examined: On dead wood, such as Quercus, Zhenping Shaanxi, alt. 1400-1600 m. X. Q. Zhang et al., VIII.14.1994, 1966 HMAS 71299; 1967 HMAS 71303; VIII.15.1994, 1972 HMAS 71300.

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FUNGAL FLORA OF THE DABA MOUNTAINS: USTILAGINALES*

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ABSTRACT: During a mycological expedition to the Daba Mountains in August of 1994, some specimens of smut fungi were collected by the author and her colleagues. These materials were identified together with several specimens kept in "Herbarium Mycologicum Instituti Microbiologi Academiae Sinicae" (HMAS). Ten species belonging to 3 genera of the Ustilaginales are reported, including a species new to China, i.e. *Urocystis ulei* Magnus on *Festuca pratensis* Hudson, indicated by an asterisk.

摘要：作者于1994年8月参加中国科学院微生物所大巴山真菌科考队，在大巴山地区进行了黑粉菌标本的采集，并研究了保藏在中国科学院微生物研究所真菌标本室的这一地区的标本，经鉴定有3属10种，其中中国新记录种一个，即寄生在草地羊茅 (*Festuca pratensis* Hudson) 上的羊茅条黑粉菌(*Urocystis ulei* Magnus)。

1. ***Sporisorium reilianum*** (Kuehn) Langdon & Fullerton, Mycotaxon 6:452, 1987.
   on *Zea mays* L., Sichuan: Wuxi, Baiguo, 1994 08 8, Guo L 1324 HMAS 71604.
2. ***Urocystis japonica*** (P. Hennings) Ling, Mycol. Papers Imp. Mycol. Inst 11:3, 1945.
   on *Anemone hupehensis* Lemoine, Shaanxi: Zhenping, Shangzhu, 1994 08 15, Guo L 1345, HMAS 69231; Zhenping, Taoyuan, 1994 08 16 Guo L 1346, HMAS 71603.

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* Supported by the Special Foundation for Floral and Taxonomic studies, Chinese Academy of Sciences

*3. ***Urocystis ulei*** Magnus, in Rabenhorst, Fungi eur. 2390, 1877.
on *Festuca pratensis* Hudson, Shaanxi:Pingli, Qianjiaping, 1994 08 18 Guo L 1348, HMAS 71627.

4. ***Ustilago calamagrostidis*** (Fuckel) Clinton, J. Mycol. 8:138, 1902.
on *Calamagrostis pseudophragmites* (Haller f.) Koeler, Shaanxi Zhenping, Baping, 1994 08 14, Guo L 1341, HMAS 71592.
on *Calamagrostis* sp., Shaanxi: Zhenping, Baping, 1994 08 14, Guo L 1343, HMAS 71591.

5. ***Ustilago commelinae*** (Komarov) Zundel, Ustil. World p.151, 1953.
on *Commelina communis* L., Sichuan:Wuxi, Hongchiba, 1994 08 2, Guo L 1312, HMAS 71602.

6. ***Ustilago hordei*** (Persoon) Lagerheim, Mitt. Bad. Bot. Vereins 1889:70 1889.
on *Avena nuda* L., Hubei: Shennongjia, 1984 08 19, Guo L HMAS 52075.

7. ***Ustilago maydis*** (DC.) Corda, Icones Fung. 5:3, 1842.
on *Zea mays* L., Shaanxi: Zhenping, Baping, 1994 08 14, Guo L 1344 HMAS 71599; Sichuan: Wuxi, Shuangyang, 1994 08 10, Zhang N 1333 HMAS 71598.

8. ***Ustilago nepalensis*** Liro, Ann. Acad. Sci. Fenn. A, 17:184, 1924.
on *Polygonum nepalense* Mein., Sichuan: Wuxi, Hongchiba, 1994 08 4 Guo L 1319, HMAS 71597; Wuxi, Baiguo, 1994 08 9, Guo L 1325 HMAS 71600; Shaanxi: Zhenping, Mt. Hualong, 1994 08 18, Guo L 1349, HMAS 71627.

9. ***Ustilago striiformis*** (Westendorp) Niessl, Hedwigia 15:1, 1876.
on *Agrostis* spp., Sichuan: Wuxi, Hongchiba, 1994 08 2, Guo L 1310 1311, 1313, HMAS 71595, 71596, 71594; Shaanxi: Pingli, Qianjiaping 1994 08 20, Wei S-x, Zhuang J-y 5413, HMAS 71601.
on *Lolium multiflorum* Lam., Sichuan: Wuxi, Hongchiba, 1994 08 3 Guo L 1317, HMAS 71593.

10. ***Ustilago syntherismae*** (Schweinitz) Peck, Ann. Rept. N.Y. State Mus 27:103, 1875.
on *Digitaria* sp., Sichuan: Dabashan, 1958 08 27, Yu Y-n, Xing Y-s 1231, HMAS 31355.

ACKNOWLEDGMENTS

The author would like to express her deep thanks to Prof. R. P. Korf and Dr. K. Vánky for reviewing the manuscript, to Profs. Zhou Gen-sheng and Liu Liang (Institute of Botany, Chinese Academy of Sciences) for identifying the host plants.

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FUNGAL FLORA OF THE DABA MOUNTAINS: UREDINALES[1]

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大巴山的菌物区系：锈菌

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摘要：本文是对中国中部大巴山区锈菌的区系调查和分类研究的报道。调查地区位于陕南和川东北的大巴山中西部。研究的标本主要是由作者1994年在这些地区采集的，少数标本由余永年、邢延苏1958年在大巴山西端所采，总共407号，经鉴定有27属123种。其中*Arthuriomyces peckianus* Cumm. & . Hirats. var. *verrucosus* N. Zhang 为新变种，*Puccinia buxi* DC., *Puccinia caricis-japonicae* Dietel 和 *Coleosporium lycopi* P. & H. Sydow 是中国的新纪录。标本存放在北京中国科学院微生物研究所真菌标本室。

INTRODUCTION

This is a report of the results of floristic investigations and taxonomic studies made through a period of two years on rust fungi (Uredinales) from the Daba Mountains in Central China. The areas

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[1] Supported by the Special Foundation for Floral and Taxonomic Studies, Chinese Academy of Sciences.

covered by the collections studied were western and central parts of the mountains in southern Shaanxi and northeastern Sichuan. The collections were made largely by the authors during their collecting trips in this region in 1994. Collections made by Y. N. Yu and J. C. Xing in 1958 were also examined. A total of 407 collections was examined, and the following 123 species belonging to 27 genera were identified. Of these, *Arthuriomyces peckianus* Cumm. & Y. Hirats. var. *verrucosus* N. Zhang is described as a new variety, and *Puccinia buxi* DC., *Puccinia caricis-japonicae* Dietel, and *Coleosporium lycopi* P. & H. Sydow are new records for China. The collections are deposited in the Mycological Herbarium, Institute of Microbiology, Chinese Academy of Sciences, Beijing (HMAS). Our thanks are extended to the Special Foundation for Floral and Taxonomic Studies, Chinese Academy of Sciences, under whose auspices this work was initiated and to the national Natural Science Foundation of China for a grant (no. 39391800) which in part supported this work.

ENUMERATION OF SPECIES

Aecidium ailanthi J. Y. Zhuang, Acta Mycol. Sin. 9: 191, 1990.

Ailanthus vilmoriniana Dode, Sichuan: Wuxi 1994 08 08, Wei Shu-xia 5324 (HMAS 70984); Sichuan: Wuxi, 1994 08 08, Zhang Ning 57 (HMAS 71318).

Picrasma quassioides (D. Don) Benn. Sichuan: Wuxi, 1994 08 08, Wei Shu-xia 5317 (HMAS 71004); Sichuan: Wuxi, 1994 08 09, Zhang Ning 80 (HMAS 71320).

Distr.: China.

Aecidium alangii Hiratsuka, Mem. Tottori Agr. Coll. 3: 329, 1935.

Alangium platanifolium Harms, Shaanxi: Zhenping, 1994 08 15, Zhang Ning 195 (HMAS 70970); Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5354 (HMAS 70969); Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5355 (HMAS 70971); Sichuan: Wuxi, 1994 08 09, Zhang Ning 108 (HMAS 70972).

Distr.: Japan, China, Korea.

Aecidium cinnamomi Raciborski, Parasitische Algen und Pilze Javas 1: 27, 1900.

Lindera umbellata Thunb., Sichuan: Wuxi, 1994 08 11, Zhang Ning 130 (HMAS 71006); Sichuan: Wuxi, 1994 08 11, Zhang Ning 145 (HMAS 71005).

Distr.: Indonesia, China.

Aecidium dispori Dietel, Engl. Bot. Jahrb. 27: 571, 1899.

Disporum cantoniense (Lour.) Merr., Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5347 (HMAS 70929).

Distr.: Japan, China.

Aecidium elaeagni-umbellatae Dietel, Engl. Bot. Jahrb. 37: 107, 1905.

Elaeagnus lanceolata Warb., Sichuan: Wuxi, 1994 08 03, Zhang Ning 16 (HMAS 70994).

Elaeagnus umbellata Thunb., Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5271 (HMAS 70992); Sichuan: Wuxi, 1994 08 04, Zhang Ning 44 (HMAS 70993).

Distr.: Japan, China.

Aecidium epimedii Hennings, Engl. Bot. Jahrb. 28: 264, 1900.

Epimedium sagittatum Maxim., Sichuan: Wuxi, 1994 08 11, Zhang Ning 141 (HMAS 70913).

Distr.: Japan, Korea, China.

Aecidium hydrangeae Patouillard., Revue Mycol. 8: 82, 1886.

Hydrangea longipes Fr., Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5272 (HMAS 70926); Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5281 (HMAS 70928); Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5337 (HMAS 70924); Sichuan: Wuxi, 1994 08 11, Zhang Ning 89 (HMAS 70927); Sichuan: Wuxi, 1994 08 09, Zhang Ning 93 (HMAS 70923); Sichuan: Wuxi, 1994 08 09, Zhang Ning 100 (HMAS 70922).

Hydrangea sp., Sichuan: Wuxi, 1994 08 04, Zhang Ning 22 (HMAS 70925).

Distr.: China.

Aecidium machili Hennings, Hedwigia 41: 21, 1902.

Lindera obtusiloba Bl., Sichuan: Dabashan, 1958 09 17, Yu & Xing 1695 (HMAS 58521).

Distr.: Japan, China, Philippines.

Aecidium philadelphi Dietel, Ann. Mycol. 12: 85, 1914.

Philadelphus incanus Koehne, Shaanxi: Zhenping, 1994 08 16, Zhang Ning 207 (HMAS 71237); Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5346 (HMAS 71236).

Philadelphus sericanthus Koehne, Sichuan: Wuxi, 1994 08 09, Zhang Ning 91 (HMAS 70968); Sichuan: Wuxi, 1994 08 13, Zhuang Jian-yun 5273 (HMAS 70967).

Distr.: Japan, China.

Remarks: This *Aecidium* has been regarded as the aecial stage of *Puccinia hikawaensis* Hiratsuka & Uchida, a bamboo rust from Japan (Uchida, 1965). Since the uredinial and telial stages have not been found in China, we maintain "*Aecidium philadelphi*" tentatively.

Aecidium rubiae Dietel, Engl. Bot. Jahrb. 34: 590, 1905.

Rubia sp., Sichuan: Dabashan, 1958 09 10, Yu & Xing 1578 (HMAS 34896).

Distr.: Japan, China.

Arthuriomyces peckianus Cummins & Y. Hiratsuka var. **verrucosus** N. Zhang var. nov. (Fig. 1)

A typo differt teliosporis omnibus verrucis numerosis irregulariter sparsis circa poros densiusculis obsitis.

Spermogoniis, aeciis et urediniis ignotis.

Teliis hypophyllis, sparsis, mox nudis, fusco-brunneis, pulverulentis, rotundatis, 0.1-0.3mm diam.; teliosporis irregularite ellipsoideis, niseptatis, ad septum non vel leviter constrictis, cinnamomeis, 35-45 X 20-25μm, membranis 1.0-1.5μm crassis, verrucis hyalinis hemisphaericis in superficiebus omnibus irregulariter distributis 3.0-4.0μm diam. 1.0-2.5μm altis circa poros manifeste confertis obsitis, poro superiore apicali, inferiore in medio, supra poros papillis hyalinis hemisphaericis minutis auctis, pedicello hyalino, brevi.

Hab. in foliis Rubi pileati Focke, Shaanxi: Pingli, 1994 08 20, Zhang Ning 272 (HMAS 71321, Typus).

Distr.: China.

Remarks: Some specimens of *Arthuriomyces peckianus* (Howe) Cummins & Hirats. (≡*Puccinia peckiana* Howe = *Gymnoconia peckiana* Trott. = *Gymnoconia interstitialis* Lagerh.) from Europe and North America are available for comparison. They are: Barth. N. Amer. Ured. 106, 1611, 1208, 2937; Ell. & Ev. Fg. Columb. 1622; Vestergr. Microm Sel. 154, 430, 631, 855. The examination of these specimens shows that the teliospores of the rust are smooth except near pores which are often surrounded by hyaline verrucae. The features of the sori and teliospores of the present Chinese collection allow immediate identification as *Arthuriomyces peckianus* although the spermogonia and aecia have not been seen. The only distinguishable feature seems to be of the slight difference of the surface sculpture of teliospores. The teliospore surface in the collection under study are almost entirely verrucose. We consider this morphological distinction is significant only at the varietal level, and therefore a new variety is proposed.

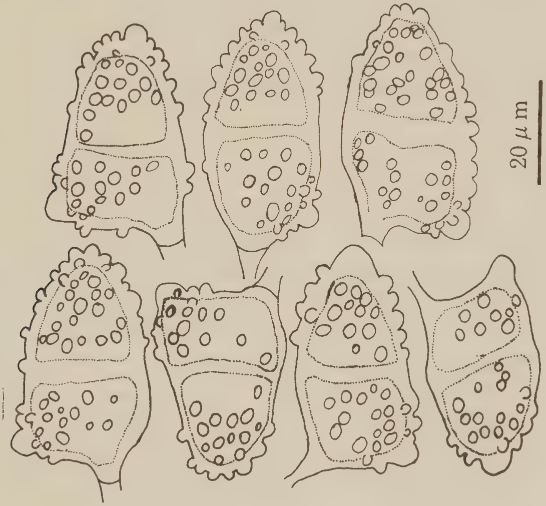

Fig. 1. Teliospores of *Arthuriomyces peckians* Cummins & Y. Hiratsuka var. *verrucosus* N. Zhang var. nov. (HMAS 71321)

Blastospora itoana Togashi & Onuma, Bot. Mag. Tokyo, 45: 6, 1931.

Smilax cocculoides Ward., Sichuan: Dabashan, 1958 11 05, Yu & Xing 1444 (HMAS 54152).

Distr.: Japan, China, Korea, Russia (Far East).

Coleopuccinia simplex Dietel, Ann. Mycol. 7: 355, 1909.

Pyracantha crenulata (D. Don) Roem., Sichan: Wuxi, 1994 08 10, Zhang Ning 125 (HMAS 71348).

Distr.: China, Japan.

Remarks: The genus *Coleopuccinia* was established by Patouillard in 1889. Only 4 species are known. All of them are parasitic on Rosaceae and distributed only in eastern Asia. *Coleopuccinia* is regarded by G. B. Cummins & Y. Hiratsuka (1984) as derivative of *Gymnosporangium*, in accordance with Tranzschel's Law. The conspicuous common character of the two genera is the gelatinous pedicel. However, *Coleopuccinia* is conspicuously different in both gross and microscopic appearance from *Gymnosporangium*. The telia of *Coleopuccinia* are very small, subglobose or hemispherical, often densely and evenly scattered over the whole leaf surface, and annual on Rosaceae. Conversely, the telia of *Gymnosporangium* are variously shaped, greatly swelling when moist, and perennial on Cupressaceae. Microscopically, the teliospores of *Coleopuccinia* are 1- celled or 2- celled in *C. sinensis* Pat., thin-walled, colourless, without germ-pores; whereas those of *Gymnosporangium* are chiefly 2-celled, rarely 3 to 4 or even 5 celled, thin-walled or thick-walled, coloured, with usually 2, rarely 1, 3 or 4 germ pores in each cell. Mycogeographically, *Gymnosporangium* is cosmopolitan while *Coleopuccinia* is East Asian. Furthermore, *Gymnosporangium* species are heteroecious with telial stage on Cupressaceae and aecial stage on Rosaceae, Hydrangiaceae and Myricaceae, while *Coleopuccinia* species are autoecious and the hosts have never been outside of Rosaceae. We consider that the peculiar characters of *Coleopuccinia* are sufficient for the need of erection of a genus. Here we support Tai (1948, 1979) and Thirumalachar & Mundkur (1949) in retaining *Coleopuccinia* as a `good' genus. Based on the 1-celled spore character in *C. simplex*, Hara (1936) established the genus *Coleopucciniella* to separate it from the 2-celled *Coleopuccinia*. The genus has been recognized by Ito (1938) and Hiratsuka et al. (1992). It seems that *Coleopucciniella* is untenable as it is based on the number of cells in a teliospore only.

Coleosporium asterum (Dietel) P. & H. Sydow, Ann. Mycol. 12: 109, 1914.

Aster ageratoides Turcz., Shaanxi: Zhenping, 1994 08 16, Wei Shu-xia 5396 (HMAS 71088); Shaanxi: Zhenping, 1994 08 16, Zhang Ning 216 (HMAS 71084); Shaanxi: Pingli, 1994 08 18, Zhang Ning 263 (HMAS 71082).

Aster albescens (DC.) Hand.-Mazz., Shaanxi: Zhenping, 1994 08 14, Wei Shu-xia 5383 (HMAS 71131); Shaanxi: Zhenping, 1994 08 14, Wei Shu-xia 5385 (HMAS 71129); Shaanxi: Zhenping, 1994 08 14, Zhang Ning 179 (HMAS 71130).

Aster sp., Shaanxi: Pingli, 1994 08 18, Wei Shu-xia 5400 (HMAS 71142); Shaanxi: Zhenping, 1994 08 16, Wei Shu-xia 5395 (HMAS 71143); Shaanxi: Zhenping, 1994 08 16, Zhang Ning 218 (HMAS

71145); Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5283 (HMAS 71146); Sichuan: Wuxi, 1994 08 08, Zhang Ning 48 (HMAS 71086); Sichuan: Wuxi, 1994 08 08, Zhang Ning 49 (HMAS 71083); Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5344 (HMAS 71087); Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5345 (HMAS 71147); Sichuan: Wuxi, 1994 08 16, Zhang Ning 5 (HMAS 71144). Sichuan: Wuxi, 1994 08 09, Zhang Ning 77 (HMAS 71085).

Distr.: Japan, Korea, Russia (Far East), China.

Remarks: This species differs from *Coleosporium pini-asteris* Orishimo (1910), a Japanese species on *Aster scaber* Thunb. first found in Tokyo, in having a cylindrical sterile cell at the base of teliospores. Host ranges of the uredinial and telial stages of the two species are different.

Coleosporium cacaliae Otth, Mitteil. Naturforsch. Ges. Bern 1865: 179, 1866.

Sinacalia tangutica (Max.) B. Nord., Shaanxi: Pingli, 1994 08 18, Wei Shu-xia 5408 (HMAS 71062); Shaanxi: Pingli, 1994 08 18, Zhang Ning 248 (HMAS 71069); Shaanxi: Pingli, 1994 08 20, Zhang Ning 288 (HMAS 71064); Shaanxi: Zhenping, 1994 08 14, Wei Shu-xia 5377 (HMAS 71068); Shaanxi: Zhenping, 1994 08 14, Zhang Ning 171 (HMAS 71063); Shaanxi: Zhenping, 1994 08 14, Zhang Ning 178 (HMAS 71065); Sichuan: Wuxi, 1994 08 03, Zhang Ning 14 (HMAS 71061); Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5285 (HMAS 71066); Sichuan: Wuxi, 1994 08 08, Wei Shu-xia 5319 (HMAS 71067).

Distr.: Europe, Japan, Korea, China.

Coleosporium carpesii Saccardo, Riv. Acc. De Padova 24: 208, 1874.

Carpesium abrotanoides L., Shaanxi: Zhenping, 1994 08 14, Zhang Ning 164 (HMAS 70899); Shaanxi: Zhenping, 1994 08 15, Zhang Ning 199 (HMAS 70902); Shaanxi: Zhenping, 1994 08 16, Wei Shu-xia 5391 (HMAS 70900); Shaanxi: Zhenping, 1994 08 16, Wei Shu-xia 5398 (HMAS 70901); Sichuan: Wuxi, 1994 08 09, Zhang Ning 64 (HMAS 70897); Sichuan: Wuxi, 1994 08 11, Zhang Ning 131 (HMAS 70898).

Distr.: Europe, Philippines, Japan, China.

Coleosporium cimicifugatum Thuemen ex Komarov, Jaczewski & Tranzschel, Fungi Ross. exs. no. 178, 1898.

Cimicifuga foetida L., Shaanxi: Pingli, 1994 08 20, Zhang Ning 316 (HMAS 70910).

Cimicifuga simplex Wormsk., Sichuan: Wuxi, 1994 08 03, Zhang Ning 10 (HMAS 71296); Sichuan: Wuxi, 1994 08 03, Zhang Ning 21 (HMAS 71297).

Cimicifuga sp., Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5280 (HMAS 70911); Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5286 (HMAS 70909).

Distr.: Russia (Far East), China, Korea, Japan.

Coleosporium clematidis Barclay, Jour. Asiat. Soc. Bengal 59: 89, 1890.

Clematis dasyandra Maxim., Shaanxi: Zhenping, 1994 08 14, Zhang Ning 170 (HMAS 71103); Sichuan: Wuxi, 1994 08 11, Zhang Ning 153 (HMAS 71105).

Clematis sp., Shaanxi: Pingli, 1994 08 20, Zhang Ning 301 (HMAS 71104); Shaanxi: Zhenping, 1994 08 16, Zhang Ning 206 (HMAS 71106).

Distr.: India, Nepal, Philippines, Korea, China, Russia (Far East), Japan, Africa.

Coleosporium evodiae Dietel, Ann. Mycol. 7: 355, 1909.

Evodia fargesii Dode, Sichuan: Dabashan, 1958 09 03, Yu & Xing 1319 (HMAS 56089).

Distr.: Japan, China.

Coleosporium ligulariae Thuemen, Bull. Soc. Imper. Nat. Moscow 52: 140, 1877.

Ligularia duciformis Hand.-Mazz., Shaanxi: Pingli, 1994 08 20, Zhang Ning 309 (HMAS 70987); Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5283A (HMAS 70985); Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5351 (HMAS 70986).

Ligularia veitchiana (Homsl.) Greenm. Sichuan: Dabashan, 1958 09 05, Yu & Xing 1462 (HMAS 55649).

Distr.: Europe, Temperate zone of Asia.

Coleosporium lycopi P. & H. Sydow, Ann. Mycol. 11: 402, 1913.

Syn. *Coleosporium hiratsukanum* Kaneko, Rept. Tottori Mycol. Inst. (Japan) 15: 23, 1977.

Adenophora capillaris Hemsl., Shaanxi: Pingli, 1994 08 18, Zhang Ning 250 (HMAS 70961).

Adenophora sp., Sichuan: Wuxi, 1994 08 11, Zhang Ning 154 (HMAS 70964).

Adenophora stricta Miq. ssp. sessiliflora Hong, Shaanxi: Pingli, 1994 08 20, Zhang Ning 306 (HMAS 70962); Shaanxi: Zhenping, 1994 08 14, Zhang Ning 168 (HMAS 70966); Sichuan: Wuxi, 1994 08 10, Zhang Ning 116 (HMAS 70965); Sichuan: Wuxi, 1994 08 10, Zhang Ning 117 (HMAS 70963); Sichuan: Wuxi, 1994 08 11, Zhang Ning 129 (HMAS 70959); Sichuan: Wuxi, 1994 08 11, Zhang Ning 151 (HMAS 70960).

Distr.: Japan, Russia (Far East), Korea, China.

Remarks: *Coleosporium lycopi* P. & H. Sydow (1913) was discribed as occurring on *Lycopus europaeus* L. (Labiatae) from Japan, but on investigating the type specimen (S), Kaneko (1981) found the host plant to be *Adenophora triphylla* DC. var. *japonica* Hara, an entirely unrelated plant in the Campanulaceae. `*Coleosporium lycopi*' is a legitimate name and can not be rejected. (Code, Art. 62). Therefore, *Coleosporium hiratsukanum* Kaneko (1977), an *Adenophora* rust identical with *C. lycopi*, is reduced to a synonym (Kaneko, 1981).

Coleosporium paederiae Dietel, Annal. Mycol. 7: 355, 1909.

Paederia scandens (Lour.) Mer., Sichuan: Wuxi, 1994 08 11, Zhang Ning 135 (HMAS 70983).

Distr.: Japan, Hawaii, Philippines, China.

Coleosporium pedicularidis Tai, Farlowia 3:100, 1947.

Pedicularis resupinata L., Shaanxi: Pingli, 1994 08 20, Zhang Ning 282 (HMAS 71001).

Pedicularis sp., Sichuan: Wuxi, 1994 08 04, Zhang Ning 45 (HMAS 71002).

Distr.: China.

Remarks: This species is only found in China, especially in Yunnan.

Coleosporium perillae P. & H. Sydow, Hedwigia 38:141, 1899.

Perilla frutescens (L.) Britton, Sichuan: Dabashan, 1958 08 27, Yu & Xing 1106 (HMAS 34988); Sichuan: Dabashan, 1958 09 02, Yu & Xing 1310 (HMAS 34999).

Distr.: India (Himalaya), Phillippines, Russia (Far East), China, Korea, Japan.

Coleosporium phellodendri Komarov, Fungi Ross. Exsic. No. 274, 1899.

Phellodendron chinense Schneid., Sichuan: Dabashan, 1958 09 06, Yu & Xing 1505 (HMAS 55661).

Distr.: China, Russia (Far East), Korea, Japan.

Coleosporium plectranthi Barclay, J. Asiatic Soc. Bengal 59: 89, 1890.

Elsholtzia ciliata (Thunb.) Hyland., Shaanxi: Pingli, 1994 08 20, Zhang Ning 308 (HMAS 71265); Shaanxi: Zhenping, 1994 08 14, Zhang Ning 160 (HMAS 71266); Shaanxi: Zhenping,1994 08 16, Zhang Ning 226 (HMAS 71264).

Rabdosia excisoides Wu et Li, Shaanxi: Pingli, 1994 08 20, Zhang Ning 315 (HMAS 71262); Sichuan: Wuxi, 1994 08 08, Zhang Ning 51 (HMAS 71261); Sichuan: Wuxi, 1994 08 09, Zhang Ning 96 (HMAS 71263).

Distr.: India (Himalaya), Philippines, Russia (Far East), China, Japan, Korea.

Coleosporium saussureae Thuemen, Bull. Soc. Imper. Nat. Moscow 55: 212, 1880.

Saussurea polycephala Hand.-Mazz., Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5307 (HMAS 70904); Sichuan: Wuxi, 1994 08 04, Zhang Ning 43 (HMAS 70904).

Saussurea sp., Shaanxi: Pingli, 1994 08 18, Wei Shu-xia 5407 (HMAS 70907); Shaanxi: Zhenping, 1994 08 15, Wei Shu-xia 5387 (HMAS 70908); Shaanxi: Zhenping, 1994 08 15, Zhang Ning 188 (HMAS 70906); Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5304 (HMAS 70905); Sichuan: Wuxi, 1994 08 09, Zhang Ning 98 (HMAS 71128).

Distr.: Russia (Far East), China, Korea, Japan.

Cronartium quercuum (Berkeley) Miyabe ex Shirai, Bot. Mag. Tokyo 13: 74, 1899.

Quercus variabilis Bl., Shaanxi: Zhenping, 1994 08 14, Zhang Ning 161 (HMAS 71282); Sichuan: Wuxi, 1994 08 10, Zhang Ning 123 (HMAS 71281).

Distr.: Japan, China, Nepal, Russia (Far East), North America, Central America.

Cronartium ribicola Fischer, Hedwigia 11: 182, 1872.

Ribes glaciale Wall., Sichuan: Dabashan, 1958 07 20, Yu & Xing 1773 (HMAS 55147).

Distr.: Europe, North America, Nepal, China, Korea, Japan, Russia (Far East).

Endophyllum maheshwarii Singh & Jalan, Indian Phytopath. 18: 32, 1965.

Schisandra sphenanthera Rehd. & Wils., Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5338 (HMAS 70915); Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5352 (HMAS 70916); Sichuan: Wuxi, 1994 08 09, Zhang Ning 85 (HMAS 70917); Sichuan: Wuxi, 1994 08 11, Zhang Ning 137 (HMAS 70918).

Distr.: India, China.

Gymnosporangium asiaticum Miyabe ex Yamada, Shokubutsu Byorigaku (Plant Pathology) Tokyo Hakubunkwan, M. 37, 9: 304, 1904.

Pyrus pyrifolia (Burm. f.) Nak., Shaanxi: Zhenping, 1994 08 14, Wei Shu-xia 5384 (HMAS 71050).

Distr.: Japan, China, Korea, U. S. A.

Gymnosporangium yamadae Miyabe ex Yamada in Omori. G. Shokubutzu Byorigaku (Plant Pathology) Tokyo Hakubunkwan, M. 37, p. 306, 1904.

Malus hupehensis (Pamp.) Rehd., Shaanxi: Zhenping, 1994 08 17, Zhang Ning 233 (HMAS 71051).

Distr.: Japan, China.

Hamaspora hashiokae Hiratsuka, Bot. Mag. Tokyo, 44: 521, 1935.

Rubus lambertianus Ser. var. *glaber* Hememsl., Sichuan: Wuxi, 1994 08 08, Wei Shu-xia 5315 (HMAS 71241); Sichuan: Wuxi, 1994 08 08, Zhang Ning 56 (HMAS 71243); Sichuan: Wuxi, 1994 08 08, Zhang Ning 60 (HMAS 71242).

Distr.: China.

Hyalopsora polypodii (Dietel) Magnus, Ber. Deut. Bot. Ges. 19: 582, 1901.

Athyrium sp., Sichuan: Wuxi, 1994 08 14, Zhang Ning 174 (HMAS 70938).

Distr.: Europe, North America, India, Russia (Far East), Japan, China.

Melampsora abietis-populi Imai, Ito & Murayama, Trans. Saporo Nat. Hist. Soc. 17: 164, 1943.

Populus wilsonii Schneid., Shaanxi: Pingli, 1994 08 20, Zhang Ning 287 (HMAS 71199).

Distr.: Japan, China.

Melampsora epitea (Kunze & Schmidt) Thuemen, Mett. Forstl. Versuchsw. West. 2: 38-40, 1879.

Salix sp., Sichuan: Dabashan, 1958 08 28, Yu & Xing 1138 (HMAS 55673).

Salix tetrasperma Roxb., Sichuan: Dabashan, 1958 08 28, Yu & Xing 1140 (HMAS 55698).

Distr.: Europe, China, Korea, Japan, North America, Russia (Far East).

Melampsora euphorbiae Castagne, Obs. Pl. Acotyl. 2: 38 & 40, 1879.

Euphorbia hylonoma Hand.-Mazz., Shaanxi: Pingli, 1994 08 18, Zhang Ning 261 (HMAS 70955); Shaanxi: Pingli, 1994 08 20, Zhang Ning 304 (HMAS 70956); Sichuan: Wuxi, 1994 08 03, Zhuang Jianyun 5278 (HMAS 70948); Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5297 (HMAS 70949); Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5303 (HMAS 70950); Sichuan: Wuxi, 1994 08 04, Zhang Ning 28 (HMAS 70945); Sichuan: Wuxi, 1994 08 04, Zhang Ning 39 (HMAS 70946); Sichuan: Wuxi, Sichuan: Wuxi, 1994 08 04, Zhang Ning 42 (HMAS 70947); 1994 08 09, Zhang Ning 99 (HMAS 70952); Sichuan: Wuxi, 1994 08 09, Zhang Ning 101 (HMAS 70953).

Euphorbia sp., Shaanxi: Pingli, 1994 08 18, Wei Shu-xia 5401 (HMAS 70957);Shaanxi: Zhenping, 1994 08 15, Zhang Ning 198 (HMAS 70944); Shaanxi: Zhenping, 1994 08 16, Zhang Ning 227 (HMAS 70958); Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5334 (HMAS 70954); Sichuan: Wuxi, 1994 08 09, Zhang Ning 97 (HMAS 70951).

Distr.: Europe, North America, Africa, China, Japan, Nepal.

Melampsora idesiae Miyabe & Hiratsuka, Bot. Mag. Tokyo, 11: 45, 1897.

Idesia polycarpa Maxim. var. *vestita* Diels, Sichuan: Dabashan, 1958 09 06, Yu & Xing 1328 (HMAS 55644).

Distr.: Japan, China.

Melampsora kusanoi Dietel, Bot. Jahrb. 37: 104, 1905.

Hypericum attenuatum Choisy, Shaanxi: Pingli, 1994 08 20, Zhang Ning 293 (HMAS 70982); Shaanxi: Zhenping, 1994 08 16, Zhang Ning 223 (HMAS 70980); Sichuan: Wuxi, 1994 08 02, Zhang Ning 2 (HMAS 70981).

Hypericum erectum Thunb. ex Murray, Shaanxi: Pingli, 1994 08 18, Zhang Ning 254 (HMAS 70979); Shaanxi: Pingli, 1994 08 20, Zhang Ning 280 (HMAS 70977).

Hypericum sp., Shaanxi: Pingli, 1994 08 20, Zhang Ning 305 (HMAS 70978).

Distr.: Japan, New Zealand, Russia (Far East), Nepal, Korea, China.

Melampsora magnusiana Wagner, Zeitschr. f. Pflanzenkr. 7: 340, 1897.

Populus davidiana Dode, Shaanxi: Pingli, 1994 08 18, Wei Shu-xia 5405 (HMAS 71201); Shaanxi: Pingli, 1994 08 18, Zhang Ning 266 (HMAS 71203); Shaanxi: Pingli, 1994 08 20, Zhang Ning 279 (HMAS 71200); Shaanxi: Pingli, 1994 08 20, Zhang Ning 311 (HMAS 71202); Shaanxi: Zhenping, 1994 08 14, Wei Shu-xia 5372 (HMAS 71206); Shaanxi: Zhenping, 1994 08 14, Zhang Ning 162 (HMAS 71204); Shaanxi: Zhenping 1994 08 14, Zhang Ning 165 (HMAS 71205).

Distr.: Europe, Russia (Far East), China, Korea, Japan.

Melampsora yezoensis Miyabe & Matsumoto, Bot. Mag. Tokyo, 40: 46, 1926.

Salix cathayana Diels, Sichuan: Wuxi, 1994 08 03, Zhang Ning 20 (HMAS 71118); Salix glandulosa Seem., Shaanxi: Pingli, 1994 08 18, Wei Shu-xia 5406 (HMAS 71119).

Salix rosthornii Seem., Shaanxi: Zhenping, 1994 08 14, Wei Shu-xia 5374 (HMAS 71107); Shaanxi: Zhenping, 1994 08 16, Wei Shu-xia 5392 (HMAS 71115); Shaanxi: Zhenping, 1994 08 16, Zhang Ning 203 (HMAS 71114); Shaanxi: Zhenping, 1994 08 16, Zhang Ning 213 (HMAS 71123).

Salix wallichiana Anderss., Shaanxi: Zhenping 1994 08 15, Zhang Ning 200 (HMAS 71122); Shaanxi: Zhenping, 1994 08 18, Zhang Ning 246 (HMAS 71121); Shaanxi: Zhenping, 1994 08 18, Zhang Ning 265 (HMAS 71116) Sichuan: Wuxi, 1994 08 03, Zhang Ning 19 (HMAS 71120).

Salix sp., Shaanxi: Pingli, 1994 08 18, Wei Shu-xia 5403 (HMAS 71108); Shaanxi: Pingli, 1994 08 18, Zhang Ning 256 (HMAS 71124); Shaanxi: Pingli, 1994 08 20, Zhang Ning 314 (HMAS 71109); Shaanxi: Zhenping, 1994 08 15, Wei Shu-xia 5388 (HMAS 71110); Sichuan: Wuxi, 1994 08 08, Zhang Ning 47 (HMAS 71117); Sichuan: Wuxi, 1994 08 08, Zhang Ning 59 (HMAS 71113); Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5327 (HMAS 71112); Sichuan: Wuxi, 1994 08 09, Zhang Ning 76 (HMAS 71111).

Distr.: Japan, China.

Remarks: The rust is characteristic because the telia are subcuticular, and the walls of paraphyses are strongly thickened at the apex (8-10μm thick). The general character of the rust indicates *Melampsora yezoensis* as the most likely species.

Melampsoridium carpini Dietel, Engl.-Prantl, Natürl. Pfl.-fam. I, 1 Abt., p. 551, 1900.

Carpinus fargesiana H. Winkl., Sichuan: Wuxi, 1994 08 09, Zhang Ning 61 (HMAS 70988); Sichuan: Wuxi, 1994 08 11, Zhang Ning 143 (HMAS 70989).

Distr.: Europe, North America, Russia (Far East), China, Japan.

Milesina exigua Faull, Jour. Arnold Arb. 12: 219, 1931.

Athyrium sp., Shaanxi: Pingli, 1994 08 20, Zhang Ning 275 (HMAS 70937); Shaanxi: Pingli, 1994 08 18, Zhang Ning 251 (HMAS 70935); Shaanxi: Pingli, 1994 08 20, Zhang Ning 285 (HMAS 70936).

Distr.: Europe, India, Russia (Far East), Korea, China, Japan.

Miyagia anaphalidis Miyabe, H. & P. Sydow, Ann. Mycol. 11: 107, 1913.

Anaphalis aureopunctata Lingelsh. et Borza, Shaanxi: Pingli, 1994 08 18, Zhang Ning 249 (HMAS 71221); Shaanxi: Pingli, 1994 08 20, Zhang Ning 277 (HMAS 70997).

Distr.: Japan, China, Russia (Far East), Nepal.

Nyssopsora cedrelae (Hori) Tranzschel, Jour. Soc. Bot. Russie, 8: 132, 1925.

Toona sinensis (A. Juss.) Roem., Shaanxi:Zhenping, 1994 08 15, Zhang Ning 191 (HMAS 71220); Shaanxi: Zhenping, 1994 08 15, Zhang Ning 193 (HMAS 71219).

Toona sp., Shaanxi: Pingli, 1994 08 18, Zhang Ning 260 (HMAS 71218); Sichuan: Wuxi, 1994 08 09, Zhang Ning 71 (HMAS 71217).

Distr.: Japan, China, Korea.

Phakopsora compositarum Miyake, Bot. Mag. Tokyo 27: 43, 1913.

Ligularia sp., Sichuan: Dabashan, 1958 07 10, Yu & Xing 1586 (HMAS 55703).

Distr.: China.

Phakopsora pachyrhizi H. & P. Sydow, Ann. Mycol. 12: 108, 1914.

Glycine max (L.) Merr., Sichuan: Dabashan, 1958 08 30, Yu & Xing 1176 (HMAS 31306).

Pueraria sp., Sichuan: Dabashan, 1958 09 20, Yu & Xing 1784 (HMAS 34572).

Distr.: Eastern to Southern Asia, Australia, Papua New Guinea, Africa.

Phragmidium assamense P. & H. Sydow, Ann. Mycol. 10: 264, 1912.

Rubus lasiostylus Focke, Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5331 (HMAS 71246).

Rubus idaeopsis Focke, Sichuan: Wuxi, 1994 08 08, Wei Shu-xia 5313 (HMAS 71247).

Rubus sp., Sichuan: Wuxi, 1994 08 08, Wei Shu-xia 5325 (HMAS 71248); Shaanxi: Zhenping, 1994 08 14, Zhang Ning 185 (HMAS 71253); Sichuan: Wuxi, 1994 08 08, Zhang Ning 55 (HMAS 71252); Shaanxi: Zhenping, 1994 08 16, Zhang Ning 208 (HMAS 71250); Sichuan: Wuxi, 1994 08 08, Zhang Ning 50 (HMAS 71251); Shaanxi: Zhenping, 1994 08 16, Wei Shu-xia 5394 (HMAS 71249).

Distr.: India, China.

Remarks: The teliospores of our collections resemble those of *Phragmidium assamense* especially in having smooth or indistinctly verrucose walls and a small apical papilla.

Phragmidium cinnamomeum Durrieu, Ctyptog. Mycol. 1(1): 51, 1980.

Rosa omeiensis Rolfe, Sichuan: Dabashan, 1958 09 05, Yu & Xing 1459 (HMAS 37236).

Distr.: Nepal, China.

Phragmidium fusiforme Schroeter, Abh. Schles. Ges. Vaterl. Cult. Nat. Abt. 1869-72, 24, 1872.

Rosa sp., Sichuan: Wuxi, 1994 08 04, Zhang Ning 24 (HMAS 71047).

Distr.: Europe, North America, Russia (Far East), Japan, China.

Phragmidium miyakeanum Hiratsuka, Trans. Tottori Soc. Agr. Sci. 2: 242, 1931.

Rubus pileatus Focke, Sichuan: Wuxi, 1994 08 04, Zhang Ning 33 (HMAS 71238); Sichuan: Wuxi, 1994 08 09, Zhang Ning 95 (HMAS 71239).

Distr.: Japan, Russia (Sakhalin), China.

Phragmidium rosae-multiflorae Dietel, Hedwigia 44: 132, 1905.

Rosa acicularis Lindl., Shaanxi: Zhenping, 1994 08 14, Wei Shu-xia 5373 (HMAS 71053); Shaanxi: Zhenping, 1994 08 14, Zhang Ning 156 (HMAS 71056).

Rosa sp., Shaanxi: Zhenping, 1994 08 16, Zhang Ning 209 (HMAS 71052); Shaanxi: Zhenping, 1994 08 16, Zhang Ning 211 (HMAS 71054); Sichuan: Wuxi, 1994 08 10, Zhang Ning 114 (HMAS 71055).

Distr.: Japan, China, Russia (Far East), Korea.

Phragmidium rubi-thunbergii Kusano, Bot. Mag. Tokyo 18: 148, 1904.

Rubus pileatus Focke, Sichuan: Wuxi, 1994 08 09, Zhang Ning 79 (HMAS 71240).

Distr.: Japan, China.

Phragmidium yamadanum Hiratsuka, Jap. Jour. Bot. 7: 242, 1935.

Rubus idaeopsis Focke, Sichuan: Wuxi, 1994 08 08, Wei Shu-xia 5320 (HMAS 71244).

Rubus sp., Shaanxi: Zhenping, 1994 08 14, Wei Shu-xia 5376 (HMAS 71245).

Distr.: Japan, China.

Physopella ampelopsidis (Dietel & P. Sydow) Cummins & Ramachar, Mycologia 50: 742, 1958.

Parthenocissus himalayana (Royle) Planch., Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5348 (HMAS 70973); Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5332 (HMAS 70975); Sichuan: Wuxi, 1994 08 09, Zhang Ning 84 (HMAS 70976); Sichuan: Wuxi, 1994 08 09, Zhang Ning 111 (HMAS 70974).

Distr.: Japan, Russia (Far East), China, Korea, Burma, Thailand, Indonesia, Philippines, Malaysia, India, Sri Landa, North and South America, West Indies.

Physopella meliosmae (Kusano) Cummins & Ramachar, Mycologia 50: 743, 1958.

Meliosma cuneifolia Fr., Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5350 (HMAS 70942); Sichuan: Wuxi, 1994 08 09, Zhang Ning 105 (HMAS 70943).

Distr.: Japan, China.

Pileolaria klugkistiana Dietel, Ann. Mycol. 19: 301, 1921.

Rhus chinensis Mill., Shaanxi: Zhenping, 1994 08 16, Zhang Ning 201 (HMAS 71322); Sichuan: Wuxi, 1994 08 11, Zhang Ning 128 (HMAS 71081); Sichuan: Wuxi, 1994 08 11, Zhang Ning 132 (HMAS 71080).

Distr.: Japan, China, Korea.

Puccinia allii (DC.) Rudolphi, Linnaea, 4: 392, 1829.

Allium sp., Sichuan: Dabashan, 1958 09 05, Yu & Xing 1464 (HMAS 35254); Sichuan: Dabashan, 1958 09 20, Yu & Xing 1791 (HMAS 34111).

Distr.: World-wide.

Puccinia antenori Zhuang & Wang, Acta Mycol. Sin. 4: 218, 1985.

Polygonum sp., Shaanxi: Zhenping, 1994 08 14, Zhang Ning 167 (HMAS 71021).

Distr.: China.

Remarks: This species has some common features with *P. polygoni-weyrichii* T. Miyake, but the urediniospores have walls of uniform thickness, while the urediniospores of the latter have walls thickened apically (5-7μm). Furthermore, the teliospore wall of this species is slightly thickened at the apex (3.5-5μm), while that of *P. polygoni-weyrichii* is uniform in thickness (2-2.5μm).

Puccinia benguetensis H. Sydow, Ann. Mycol. 15: 174, 1917.

Arthraxon hispidus (Th.) Makino, Sichuan: Wuxi, 1994 08 10, Zhang Ning 119 (HMAS 71167).

Distr.: Russia (Far East), Japan, China, Philippines.

Puccinia bistortae (Strauss) de Candolle, Flore Francaise 6:61, 1815.

Polygonum viviparum L., Sichuan: Wuxi, 1994 08 03, Zhuang & Wei 5285A (HMAS 71039); Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5294 (HMAS 71037).

Distr.: Europe, North America, Russia (Far East), Korea, Japan, China.

Puccinia bolleyana Saccardo, Syll. Fung. 9: 303, 1891.

Sambucus chinensis Lindl., Sichuan: Wuxi, 1994 08 09, Zhang Ning 72 (HMAS 71233).

Distr.: Asia, Russia, U. S. A.

Remarks: We cannot assure that this collection is correctly identified since it is represented by the aecial stage only. The connection with uredinia and telia on *Carex* has not been demonstrated in China.

Puccinia brachypodii Otth var. *arrhenatheri* (Kleb.) Cummins & H. C. Greene, Mycologia, 58: 709, 1966.

Dactylis glomerata L., Shaanxi: Pingli, 1994 08 20, Zhang Ning 283 (HMAS 71183); Shaanxi: Pingli, 1994 08 20, Zhang Ning 284 (HMAS 71182).

Distr.: World-wide.

Puccinia brachypodii Otth var. *poae-nemoralis* (Otth) Cummins & H. C. Greene, Mycologia, 58: 705, 1966.

Poa sp., Shaanxi: Pingli, 1994 08 18, Wei Shu-xia 5412 (HMAS 71165).

Distr.: World-wide.

Puccinia brachystachyicola Hino & Katumoto, Bull. Fac. Agr. Yamaguti Univ. 11: 30, 1960.

Sinarundinaria nitida (Metford) Nakai, Sichuan: Wuxi, 1994 08 09, Zhang Ning 78 (HMAS 71166).

Distr.: China.

Remarks: This rust is somewhat similar to *Puccinia longicornis* Pat. & Har., but the uredinia are wanting and the apical walls of teliospores are less thickened.

Puccinia bupleuri Rudolphi, Linnaea 4: 514, 1829.

Bupleurum sp., Shaanxi: Zhenping, 1994 08 16, Zhang Ning 204 (HMAS 71003).

Distr.: Europe, Russia (Far East), China, Korea, Japan.

Remarks: The arrangement of urediniospore pores seems variable. Li (1989) stated that the urediniospores had 3 equatorial germ pores. According to Ito (1950) the germ pores were indistinct, probably 3-5. Our collection shows the germ pores are 3-4, scattered or indistinct.

Puccinia buxi DC., Fl. Franc. 6: 60, 1815.

Buxus sinica (R. et W.) Cheng var. *punila* M. Cheng, Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5335 (HMAS 71126).

Distr.: Europe; Japan, China.

Remarks: This species is new to China.

Puccinia caricis-blepharicarpae Hiratsuka, Tran. Sapporo Nat. Hist. Soc. 18: 84-88, 1949.

Smilax discotis Warb, Sichuan: Dabashan, 1958 08, Yu & Xing 1522 (HMAS 54166).

Distr.: Japan, China.

Puccinia caricis-japonicae Dietel, Ann. Mycol. 4: 306, 1906.

Carex sp., Shaanxi: Pingli, 1994 08 18, Zhang Ning 252 (HMAS 70831).

Distr.: Japan, China.

Remarks: This species is characterised by the yellowish urediniospores with 4 (or sometimes 3) equatorial germ pores. The teliospores are clavate, 38-55 X 12-18 µm, with thickened apical wall (5-11 µm thick) and very short (about 25 µm) pedicels. *P. caricis- japonicae* differs from *P. caricis-thunbergii* Homma only in lacking uredinial paraphyses.

Puccina coronata Corda var. **avenae** Fraser & Ledingham, Sci. Agr. 13: 322, 1933.

Avena nuda L., Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5292 (HMAS 71184); Sichuan: Wuxi, 1994 08 04, Zhang Ning 29 (HMAS 71185).

Distr.: World-wide.

Puccinia coronata Corda, Icon. Fung. 1: 6, 1837. var. **coronata**

Agrostis sp., Shaanxi: Pingli, 1994 08 18, Wei Shu-xia 5410 (HMAS 71175); Shaanxi: Pingli, 1994 08 18, Zhang Ning 264 (HMAS 71290); Shaanxi: Pingli, 1994 08 20, Zhang Ning 273 (HMAS 71174); Shaanxi: Pingli, 1994 08 20, Zhang Ning 291 (HMAS 71180); Shaanxi: Pingli, 1994 08 20, Zhang Ning 302 (HMAS 71176); Shaanxi: Zhenping, 1994 08 14, Zhang Ning 163 (HMAS 71291); Shaanxi: Zhenping, 1994 08 15, Zhang Ning 187 (HMAS 71179); Shaanxi: Zhenping, 1994 08 18, Zhang Ning 245 (HMAS 71177); Sichuan: Wuxi, 1994 08 03, Zhang Ning 18 (HMAS 71178); Sichuan: Wuxi, 1994 08 02, Zhang Ning 3 (HMAS 71181).

Deyeuxia langsdorffii (Link.) Kunth, Shaanxi: Zhenping, 1994 08 17, Zhang Ning 230 (HMAS 71194); Shaanxi: Zhenping, 1994 08 17, Zhang Ning 232 (HMAS 71195).

Distr.: World-wide.

Puccinia coronata Corda var. **himalensis** Barclay, Trans. Linn. Soc. London 3: 227. 1891.

Brachypodium sylvaticum (Huds.) Beauv., Sichuan: Wuxi, 1994 08 11, Zhang Ning 152 (HMAS 71295).

Brachypodium sp., Shaanxi: Zhenping, 1994 08 16, Zhang Ning 214 (HMAS 71294); Shaanxi: Zhenping, 1994 08 17, Zhang Ning 228 (HMAS 71198); Shaanxi: Zhenping, 1994 08 17, Zhang Ning 238 (HMAS 71197); Sichuan: Wuxi, 1994 08 02, Wei Shu-xia 5267 (HMAS 71292); Sichuan: Wuxi, 1994 08 02, Wei Shu-xia 5269 (HMAS 71196); Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5279 (HMAS 71293).

Distr.: India, China, Japan, Europe, North and South America.

Puccinia dieteliana P. Sydow in Dietel, Hedwigia, 37: 215, 1898.

Lysimachia clethroides Dudy, Shaanxi: Zhenping, 1994 08 14, Zhang Ning 173 (HMAS 70941); Sichuan: Wuxi, 1994 08 11, Zhang Ning 148 (HMAS 70940).

Distr.: Japan, Russia (Far East), China, Korea.

Puccinia dioicae Magnus, Amtl. Ber. 50 Versamml. Deut. Naturf. Arzte, Munchen, 199, 1877.

Carex sp., Shaanxi: Pingli, 1994 08 20, Zhang Ning 255 (HMAS 71305); Shaanxi: Pingli, 1994 08 20, Zhang Ning 281 (HMAS 71306).

Distr.: Europe, Asia.

Puccinia dioscoreae Komarov, Fungi Ross. Exs. no. 269, 1899.

Dioscorea nipponica Mak. var. *rosthoranii* Prain et Burkell, Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5343 (HMAS 71018); Sichuan: Wuxi, 1994 08 09, Zhang Ning 82 (HMAS 70895); Sichuan: Wuxi, 1994 08 09, Zhang Ning 109 (HMAS 70896).

Distr.: Russia (Far East), China, Japan.

Puccinia ferruginea Léveillé in Vaillant, Voyage de la Bonite, Fungi, 204, 1839-1846.

Smilax sp., Shaanxi: Langao, 1994 08 19, Zhang Ning 270 (HMAS 71020).

Distr.: China, New Guinea, Indonesia, Philippines, Japan.

Remarks: This species may be confused with *P. citrina* P. & H. Sydow but the latter is distinguished by its larger teliospores and the presence of very large thick-walled urediniospores. The teliospores are lepto-form, which germinate without a period of rest.

Puccinia fusispora P. & H. Sydow, Monogr. Ured. 1: 590, 1903.

Laportea bulbifera (Sieb. & Zucc.) Wedd., Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5305 (HMAS 71125).

Distr.: China, Japan.

Puccinia graminis Persoon, Synopsis Methodica Fungorum, 228, 1801.

Berberis dolichobotrys Fedde, Sichuan: Wuxi, 1994 08 04, Zhang Ning 32 (HMAS 70912).

Distr.: World-wide.

Remarks: The aecia only have been found.

Puccinia haleniae Arthur & Holway, Bull. Geol. Nat. Hist. Surv. Minn. 3: 30, 1887.

Halenia elliptica D. Don, Shaanxi: Pingli, 1994 08 20, Zhang Ning 286 (HMAS 71127).

Distr.: North America, China, Korea, Russia (Kamchatka), Japan.

Puccinia hanyuenensis Tai, Acta Phytotax. Sin. 11: 343, 1973.

Polygonum amplexicaule D. Don, Shaanxi: Pingli, 1994 08 20, Zhang Ning 294 (HMAS 71032).

Distr.: China.

Puccinia hemerocallidis Thuemen, Bull. Soc. Imp. Nat. Moscow 55: 81, 1880.

Hemerocallis sp., Shaanxi: Zhenping, 1994 08 14, Wei Shu-xia 5381 (HMAS 70894).

Distr.: Russia (Far East), Japan, China, Korea.

Puccinia hieracii Martius, Prodr. Flora Mosq. Ed. 2, 227, 1817.

Picris hieracioides L. ssp. *japonica* Krylv., Shaanxi: Pingli, 1994 08 18, Wei Shu-xia 5411 (HMAS 71077); Shaanxi: Pingli, 1994 08 20, Zhang Ning 274 (HMAS 71079); Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5290 (HMAS 71075); Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5295 (HMAS 71078); Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5311 (HMAS 71076).

Taraxacum mongolicum Hand.-Mazz., Shaanxi: Zhenping, 1994 08 15, Zhang Ning 186 (HMAS 71074).

Taraxacum sp., Sichuan: Wuxi, 1994 08 10, Zhang Ning 120 (HMAS 71073).

Distr.: World-wide.

Puccinia iridis Rabenhorst, Deutschl. Krypt. Fl. 1: 23, 1844.

Iris tectorum Max., Sichuan: Wuxi, 1994 08 08, Zhang Ning 53 (HMAS 70892); Sichuan: Wuxi, 1994 08 09, Zhang Ning 107 (HMAS 70893).

Distr.: Europe, North America, New Zealand, Russia (Far East), China, Korea, Japan, India.

Puccinia kusanoi Dietel, Bot. Jahrb. 27: 568, 1899.

Bambusa sp., Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5275 (HMAS 71323).

Distr.: Japan, China.

Remarks: All collections previously referred to this species so far seen in China show only aecia occurring on species of *Deutzia.* No reliable records of uredinial and telial stages were found. The present collection on *Bambusa* sp. is very meager and the teliospores have germinated and collapsed. Therefore, the assignment of the collection to this species is somewhat uncertain. However, the size of the urediniospores, thickness of wall, pore number and arrangement, and dimorphic features of teliospores are all characters that agree with those of the spores of this species.

Puccinia lactucae-debilis Dietel, Ann. Mycol. 6: 225, 1908.

Ixeris denticulata (Houtt.) Stebb., Sichuan: Wuxi, 1994 08 08, Wei Shu-xia 5318 (HMAS 71049); Sichuan: Wuxi, 1994 08 09, Zhang Ning 62 (HMAS 71048).

Distr.: Japan, China, Korea, Russia (Far East).

Puccinia lapathicola Hylander, Joerstad & Nannfeldt, Opera Bot. 1: 66, 1953.

Rumex nepalensis Spreng., Shaanxi: Pingli, 1994 08 20, Zhang Ning 292 (HMAS 71212); Sichuan: Wuxi, 1994 08 10, Wei Shu-xia 5365 (HMAS 71211).

Distr.: North America, Mexico, Central America, Japan, China.

Puccinia ligusticola Miyake, Jour. Sapporo Agr. Coll. 2: 118, 1906.

Angelica polymorpha Maxim., Sichuan: Dabashan, 1958 09 07, Yu & Xing 1387 (HMAS 65716).

Distr.: Japan, Russia (Far East), China.

Puccinia longicornis Patouillard & Hariot, Bull. Soc. Mycol. Fr. 7: 143, 1891.

Indocalamus sp., Sichuan: Wuxi, 1994 08 11, Zhang Ning 139 (HMAS 71169); Sichuan: Wuxi, 1994 08 11, Zhang Ning 147 (HMAS 71168).

Distr.: Japan, China.

Puccinia melanocephala H. Sydow & P. Sydow in Sydow & Butler, Ann. Mycol. 5: 500,1907.

Erianthus rufipilus (Steud.) Griseb., Shaanxi: Pingli, 1994 08 18, Zhang Ning 259 (HMAS 71325); Sichuan: Wuxi, 1994 08 10, Wei Shu-xia 5362 (HMAS 71164).

Miscanthus sp., Shaanxi: Pingli, 1994 08 18, Wei Shu-xia 5410 (HMAS 71172); Shaanxi: Zhenping, 1994 08 14, Wei Shu-xia 5369 (HMAS 71171); Shaanxi: Zhenping, 1994 08 17, Zhang Ning 242 (HMAS 71170).

Distr.: North and Central America, India, China, Japan, Australia.

Remarks: The apices of paraphyses and teliospores are purple-brown, darker than other parts.

Puccinia menthae Persoon, Synopsis Methodica Fungorum, 227, 1801.

Clinopodium polyciphalum (Vaniot) Wu & Hsuan, Shaanxi: Pingli, 1994 08 20, Zhang Ning 295 (HMAS 71254).

Mentha haplocalyx Briq., Shaanxi: Pingli, 1994 08 20, Zhang Ning 296 (HMAS 71255); Shaanxi: Zhenping, 1994 08 14, Wei Shu-xia 5379 (HMAS 71257); Shaanxi: Zhenping, 1994 08 14, Wei Shu-xia 5382 (HMAS 71259); Shaanxi: Zhenping, 1994 08 17, Zhang Ning 240 (HMAS 71260); Sichuan: Wuxi, 1994 08 03, Zhang Ning 15 (HMAS 71256); Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5288 (HMAS 71258).

Distr.: World-wide.

Puccinia minussensis Thuemen, Bull. Soc. Imp. Nat. Moscow 53: 214, 1878.

Lactuca raddeana Maxim., Shaanxi: Zhenping, 1994 08 14, Zhang Ning 169 (HMAS 71058); Shaanxi: Zhenping, 1994 08 16, Wei Shu-xia 5399 (HMAS 71060); Shaanxi: Zhenping, 1994 08 16, Zhang Ning 221 (HMAS 71057); Shaanxi: Zhenping 1994 08 17, Zhang Ning 235 (HMAS 71059).

Distr.: Russia (Far East), Europe, North America, Japan, Korea, China.

Puccinia nanbuana Hennings, Hedwegia 40: 26, 1901.

Angelica dahurica (Fisch. ex Hoffm.) Benth. & Hook. f. ex Franch. & Savat., Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5282 (HMAS 71141); Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5329 (HMAS 71139).

Angelica polymorpha Max., Shaanxi: Zhenping, 1994 08 14, Zhang Ning 176 (HMAS 71137); Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5274 (HMAS 71140).

Angelica sp., Sichuan: Wuxi, 1994 08 09, Zhang Ning 67 (HMAS 71138).

Distr.: Japan, Russia (Far East), Korea, China.

Puccinia neyraudiae H. Sydow & P. Sydow in H. Sydow, P. Sydow & Butler, Ann. Mycol. 10: 260, 1912.

Microstegium sp.?, Shaanxi: Zhenping, 1994 08 16, Zhang Ning 205 (HMAS 71286).

Distr.: India, China.

Remarks: The inflorescence does not accompany the collection and specific determination of the host plant is impractical. *P. neyraudiae* has not before been reported on *Microstegium*, and the assignment of the collection to this species is somewhat uncertain.

Puccinia nishidana Hennings, Hedwigia, 40: 26, 1901.

Cirsium japonicum Fisch. ex DC., Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5293 (HMAS 71091).

Cirsium sp., Shaanxi: Zhenping, 1994 08 16, Wei Shu-xia 5393 (HMAS 71089);Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5330 (HMAS 71092); Sichuan: Wuxi, 1994 08 09, Zhang Ning 75 (HMAS 71090).

Distr.: Japan, China, Korea, Russia (Far East).

Puccinia oenanthes-stoloniferae Ito ex Tranzschel, Consp. Ured. URSS, 299, 1939.

Oenanthe javanica (Bl.) DC., Shaanxi: Zhenping, 1994 08 14, Wei Shu-xia 5378 (HMAS 71149); Shaanxi: Zhenping, 1994 08 14, Zhang Ning 180 (HMAS 71148); Sichuan: Wuxi, 1994 08 10, Wei Shu-xia 5364 (HMAS 71150).

Distr.: Japan, Russia (Siberia), China.

Puccinia pimpinellae Roehling, Deutschl. Fl. Ed. 2, 3: 131, 1913.

Pimpinella sp., Sichuan: Dabashan, 1958 09 06, Yu & Xing 1354 (HMAS 58046).Sichuan: Dabashan, 1958 09 13, Yu & Xing 1629 (HMAS 58045).

Distr.: Europe, China, Japan.

Puccinia polygoni-amphibii Persoon, Synopsis Methodica Fungorum 227, 1801.

Antenoron neofiliforme (Nak.) Hara, Shaanxi: Zhenping, 1994 08 15, Zhang Ning 194 (HMAS 71208); Shaanxi: Zhenping, 1994 08 16, Wei Shu-xia 5397 (HMAS 71210); Shaanxi: Zhenping, 1994 08 16, Zhang Ning 225 (HMAS 71209); Sichuan: Wuxi, 1994 08 09, Zhang Ning 65 (HMAS 71207).

Polygonum dentato-alatum F. Schmidt ex Max., Shaanxi: Pingli, 1994 08 20, Zhang Ning 298 (HMAS 71038).

Polygonum multiflorum Thunb., Shaanxi: Pingli, 1994 08 20, Zhang Ning 307 (HMAS 71326).

Polygonum pinetorum Hemsl, Shaanxi: Pingli, 1994 08 18, Wei Shu-xia 5404 (HMAS 71024); Shaanxi: Pingli, 1994 08 18, Zhang Ning 262 (HMAS 71027); Shaanxi: Pingli, 1994 08 20, Zhang Ning 300 (HMAS 71046); Shaanxi: Zhenping, 1994 08 18, Zhang Ning 244 (HMAS 71030); Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5289 (HMAS 71022); Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5296 (HMAS 71025); Sichuan: Wuxi, 1994 08 04, Zhang Ning 35 (HMAS 71043).

Distr.: Europe, Africa, North America, Mexico, Hawaii, New Zealand, Russia (Far East), Japan, China.

Puccinia polygonicola Tai, Farlowia 3: 122, 1947.

Polygonum nepalense Meisn., Shaanxi: Zhenping, 1994 08 16, Zhang Ning 212 (HMAS 71044); Shaanxi: Zhenping, 1994 08 16, Zhang Ning 217 (HMAS 71034); Shaanxi: Zhenping, 1994 08 17, Zhang Ning 243 (HMAS 71042); Sichuan: Wuxi, 1994 08 10, Wei Shu-xia 5363 (HMAS 71045).

Polygonum posumbu Hamilt., Sichuan: Wuxi, 1994 08 10, Wei Shu-xia 5359 (HMAS 71035).

Polygonum runcinatum Buch.-Ham., Shaanxi: Zhengping, 1994 08 16, Zhang Ning 220 (HMAS 71026); Sichuan: Wuxi, 1994 08 04, Zhang Ning 41 (HMAS 71028); Sichuan: Wuxi, 1994 08 09, Zhang Ning 81 (HMAS 71023); Sichuan: Wuxi, 1994 08 09, Zhang Ning 94 (HMAS 71033); Sichuan: Wuxi, 1994 08 09, Zhang Ning 110 (HMAS 71031); Sichuan: Wuxi, 1994 08 10, Zhang Ning 118 (HMAS 71029).

Distr.: China.

Remarks: The peculiar character of this species is that the urediniospores have 2-3 basal germ pores.

Puccinia pygmaea Eriksson, Bot. Centralbl. 64: 381, 1895.

Asperella sp., Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5309 (HMAS 71163).

Distr.: World-wide.

Remarks: This rust is variable and Cummins (1971) has proposed segregation of 4 varieties based on different measurements of urediniospores and teliospores. We consider that the differences in spore size are insignificant taxonomically.

Puccinia septentrionalis Juel, Oefv. Sv. Vet-Akad. Foerh. 52: 383, 1895.

Polygonum suffultum Maxim., Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5277 (HMAS 71040); Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5341 (HMAS 71040); Sichuan: Wuxi, 1994 08 09, Zhang Ning 88 (HMAS 71224).

Distr.: Canada, Alaska, Iceland, Northern Europe, China, Japan.

Puccinia sorghi Schweinitz, Trans. Amer. Phil. Soc. II, 4: 295, 1832.

Zea mays L., Shaanxi: Zhenping, 1994 08 14, Wei Shu-xia 5371 (HMAS 71189); Shaanxi: Zhenping, 1994 08 14, Zhang Ning 155 (HMAS 71190); Shaanxi: Zhenping, 1994 08 14, Zhang Ning 181 (HMAS 71193); Shaanxi: Zhenping, 1994 08 17, Zhang Ning 239 (HMAS 71192); Sichuan: Wuxi, 1994 08 02, Wei Shu-xia 5266 (HMAS 71188); Sichuan: Wuxi, 1994 08 02, Zhang Ning 4 (HMAS 71187); Sichuan: Wuxi, 1994 08 03, Zhang Ning 8 (HMAS 71186); Sichuan: Wuxi, 1994 08 10, Wei Shu-xia 5361 (HMAS 71191).

Distr.: World-wide.

Puccinia stellariicola Cummins, Mycologia, 43: 81, 1951.

Stellaria sp., Shaanxi: Zhenping, 1994 08 17, Zhang Ning 237 (HMAS 71231).

Distr.: China.

Puccinia yokogurae Hennings, Ann. Mycol. 11: 104, 1913.

Carex sp., Shaanxi: Langao, 1994 08 19, Zhang Ning 268 (HMAS 71304).

Distr.: Japan, China.

Pucciniastrum agrimoniae (Dietel) Tranzschel, Script. Bot. Hort. Univ. Petrop. 4: 301, 1895.

Agrimonia pilosa Ledeb., Shaanxi: Pingli, 1994 08 20, Zhang Ning 299 (HMAS 71010); Shaanxi: Zhenping, 1994 08 14, Zhang Ning 166

(HMAS 71008); Shaanxi: Zhenping, 1994 08 15, Zhang Ning 189 (HMAS 71011); Sichuan: Wuxi, 1994 08 02, Zhang Ning 6 (HMAS 71012); Sichuan: Wuxi, 1994 08 03, Zhang Ning 12 (HMAS 71014); Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5284A (HMAS 71007); Sichuan: Wuxi, 1994 08 04 Wei Shu-xia 5308 (HMAS 71015); Sichuan: Wuxi, 1994 08 04, Zhang Ning 25 (HMAS 71009); Sichuan: Wuxi, 1994 08 04, Zhang Ning 37 (HMAS 71013).

Distr.: World-wide.

Pucciniastrum corni Dietel, Engl. Bot. Jahrb. 34: 587, 1905.

Cornus controversa Hemsl., Sichuan: Wuxi, 1994 08 08, Wei Shu-xia 5312 (HMAS 70914).

Distr.: Japan, China.

Pucciniastrum epilobii Otth, Mitteil. Naturf. Ges. Bern 71: 72, 1861.

Chamaenerion angustifolium (L.) Scop., Shaanxi: Pingli, 1994 08 18, Zhang Ning 267 (HMAS 70995); Shaanxi: Pingli, 1994 08 20, Zhang Ning 310 (HMAS 70996).

Distr.: Europe, North America, Central America, South America, New Zealand, Russia (Far East), China, Korea, Japan.

Pucciniastrum hydrangeae-petiolaris Hiratsuka, Jour. Facul. Agric. Hokkaido Imp. Univ. 21: 27, 1927.

Hydrangea sp., Sichuan: Wuxi, 1994 08 09, Zhang Ning 69 (HMAS 71000).

Distr.: Japan, Russia (Sakhalin), China, Nepal.

Pucciniostele mandshurica Dietel., Ann. Mycol. 2: 21, 1904.

Astilbe chinensis (Max.) Fr. et Sav., Shaanxi: Pingli, 1994 08 18, Zhang Ning 257 (HMAS 71287); Shaanxi: Pingli, 1994 08 20, Zhang Ning 271 (HMAS 71288).

Astilbe myriantha Diels., Shaanxi: Pingli, 1994 08 20, Zhang Ning 303 (HMAS 71289).

Distr.: China, Korea, Japan, Russia (Far East).

Tranzschelia fusca (Persoon) Dietel, Ann. Mycol. 20: 31, 1922.

Thalictrum minus L. var. *hypoleucum* (Sieb. & Zucc.) Miq., Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5302 (HMAS 70919); Sichuan: Wuxi, 1994 08 04, Zhang Ning 38 (HMAS 70920); Sichuan: Wuxi, 1994 08 04,Zhang Ning 40 (HMAS 70921).

Distr.: Europe, North America, China, Russia (Far East), Japan.

Uredinopsis hirosakiensis Kamei & Hiratsuka, Trans. Sapporo Nat. Hist. Soc. 12: 164, 1932.

Dryopteris sp., Shaanxi: Zhenping, 1994 08 17, Zhang Ning 231 (HMAS 70933); Shaanxi: Zhenping, 1994 08 17, Zhang Ning 241 (HMAS 70934).

Distr.: Japan, Russia (Far East), China, Korea.

Uredinopsis struthiopteridis Stoermer ex Dietel, Ber. Deutsch. Bot. Ges. 13: 331, 1895.

Lunathyrium acrostichoides (Sw.) Ching, Shaanxi: Zhenping, 1994 08 17, Zhang Ning 229 (HMAS 70999); Sichuan: Wuxi, 1994 08 03, Zhang Ning 13 (HMAS 70998).

Distr.: Europe, North America, China, Japan, Russia (Far East).

Uredo alpestris Schroeter, Jahresber. Schles. Ges. f. Vaterl. Kultur. 53: 117, 1875.

Viola acuminata Ledeb., Shaanxi: Zhenping, 1994 08 14, Zhang Ning 172 (HMAS 71230); Sichuan: Wuxi, 1994 08 03, Zhuang Jian-yun 5284 (HMAS 71229); Sichuan: Wuxi 1994 08 04, Zhang Ning 34 (HMAS 71228); Sichuan: Wuxi, 1994 08 11, Zhang Ning 150 (HMAS 71227).

Viola vaginata Maxim., Shaanxi: Zhenping, 1994 08 09, Zhang Ning 196 (HMAS 71225); Sichuan: Wuxi, 1994 08 09, Zhang Ning 90 (HMAS 71226).

Distr.: Europe, Russia (Far East), China, India, Japan.

Uredo grewiae Patouillard & Hariot, Jour. Bot. 14: 237, 1900.

Grewia sp., Hubei: Yichang, 1994 07 30, Zhuang Jian-yun 5264 (HMAS 71232).

Distr.: China, Africa.

Uredo yamadana Hiratsuka, Trans. Mycol. Soc. Japan, 5: 3, 1957.

Coniogramme suprapilosa Ching, Sichuan: Wuxi, 1994 08 08, Zhang Ning 46 (HMAS 70939).

Distr.: Japan, China, Nepal.

Uromyces appendiculatus (Persoon) Unger, Einfl. Bodens 216, 1836.

Phaseolus sp., Sichuan: Dabashan, 1958 08 06, Yu & Xing 1320 (HMAS 34557); Sichuan: Dabashan, 1958 08 28, Yu & Xing 1126

(HMAS 34559); Sichuan: Dabashan, 1958 09 01, Yu & Xing 1221 (HMAS 31481).

Phaseolus vulgaris L., Shaanxi: Zhenping, 1994 08 15, Wei Shu-xia 5386 (HMAS 71280); Shaanxi: Zhenping, 1994 08 15, Zhang Ning 190 (HMAS 71279); Sichuan: Wuxi, 1994 08 10, Wei Shu-xia 5360 (HMAS 71278); Sichuan: Wuxi, 1994 08 10, Zhang Ning 127 (HMAS 71277).

Distr.: World-wide.

Uromyces ervi Westendorp, Bull. Acad. Roy. Sc. Belg. 21: 246, 1854.

Vicia bungei Ohwi, Shaanxi: Pingli, 1994 08 20, Zhang Ning 289 (HMAS 71213).

Vicia sepium L., Shaanxi: Pingli, 1994 08 18, Wei Shu-xia 5409 (HMAS 71214); Shaanxi: Pingli, 1994 08 18, Zhang Ning 253 (HMAS 71216); Shaanxi: Pingli, 1994 08 20, Zhang Ning 276 (HMAS 71215).

Distr.: Europe, Russia (Siberia), Azerbaijan, China, Korea, Japan.

Uromyces fallens Kern, Phytopathology 1: 6, 1911.

Trifolium pratense L., Sichuan: Wuxi, 1994 08 02, Wei Shu-xia 5261 (HMAS 71273); Sichuan: Wuxi, 1994 08 02, Zhang Ning 1 (HMAS 71271); Sichuan: Wuxi, 1994 08 03, Zhang Ning 17 (HMAS 71272).

Distr.: Europe, North America, China, Japan, Pakistan, New Zealand.

Remarks: This species is regarded by Cummins (1977) as a variety of *Uromyces trifolii-repentis* Liro. However, it is notably distinct from *U. trifolii-repentis* in having more and scattered germ pores of urediniospores. It appears to be sufficiently distinct to merit a separate species name.

Uromyces geranii Fries, Summa Veg. Scand. 514, 1849.

Geranium henryi R. Knuth, Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5306 (HMAS 71234).

Distr.: Europe, Russia (Far East), Pakistan, China, Japan.

Uromyces kaimontanus Hiratsuka & S. Sato, Trans. Mycol. Soc. Japan 1: 2-3, 1959.

Veratrum nigrum L., Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5301 (HMAS 70931); Sichuan: Wuxi, 1994 08 04, Zhang Ning 23 (HMAS 70930); Sichuan: Wuxi, 1994 08 04, Zhang Ning 27 (HMAS 70932).

Distr.: Japan, China.

Uromyces lespedezae-procumbentis Curtis, Geol. Surve N. Carol. 3: 123, 1867.

Lespedeza cyrtobotrya Miq., Shaanxi: Zhenping, 1994 08 14, Zhang Ning 183 (HMAS 71134).

Lespedeza floribunda Bge., Shaanxi: Langao, 1994 08 19, Zhang Ning 269 (HMAS 71136); Lespedeza formosana (Vog.) Koehne, Shaanxi: Zhenping, 1994 08 14, Zhang Ning 157 (HMAS 71132); Shaanxi: Zhenping, 1994 08 16, Zhang Ning 202 (HMAS 71133); Shaanxi: Zhenping, 1994 08 17, Zhang Ning 234 (HMAS 71135).

Kummerowia striata (Thunb.) Schindl., Shaanxi: Zhenping, 1994 08 14, Zhang Ning 182 (HMAS 71276); Shaanxi: Zhenping, 1994 08 16, Zhang Ning 210 (HMAS 71275).

Distr.: North America, China, Japan, Russia (Far East), Korea, Pakistan, North America.

Uromyces mucunae Rabenhorst, Hedwigia 17: 62, 1878.

Mucuna sempervirens Hemsl., Sichuan: Wuxi, 1994 08 09, Wei Shu-xia 5340 (HMAS 71235).

Distr.: South Africa, India, Philippines, China, Japan.

Uromyces polygoni-avicularis Karsten, Mycol. Fenn. 4: 12, 1879.

Polygonum aviculare L., Shaanxi: Zhenping, 1994 08 14, Zhang Ning 159 (HMAS 71036).

Distr.: World-wide.

Uromyces rugulosus Patouillard, J. Bot. 2: 151, 1888.

Lespedeza formosana (Vog.) Koehne, Shaanxi: Zhenping, 1994 08 14, Wei Shu-xia 5370 (HMAS 71151).

Distr.: China.

Uromyces scaberulus L. Guo & Wang, Acta Mycol. Sin. Suppl. I, 1986.

Lespedeza bicolor Turcz., Sichuan: Dabashan, 1958 09 05, Yu & Xing 1391 (HMAS 35456).

Distr.: China.

Uromyces trifolii Fuckel, Symb. Mycol. 63, 1870.

Trifolium repens L., Sichuan: Wuxi, 1994 08 02, Wei Shu-xia 5268 (HMAS 71274).

Distr.: World-wide.

Xenodochus carbonarius Schlechtendal, Linnaea 1: 237, 1826.

Sanguisorba officinalis L., Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5291 (HMAS 71285); Sichuan: Wuxi, 1994 08 04, Wei Shu-xia 5310 (HMAS 71283); Sichuan: Wuxi, 1994 08 04, Zhang Ning 26 (HMAS 71284).

Distr.: World-wide.

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Myrothecium renaudii sp. nov. ON *Heliconia psittacorum* X *H. spathocircinata*.

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ABSTRACT

Myrothecium renaudii **sp. nov.** is described and illustrated from inflorescences of *Heliconia psittacorum* x *H. spathocircinata* 'Golden Torch' and 'Tropic', collected in Venezuela. The new species differs from *M. atrum* mainly by having an indeterminate synnema, and from *M. flavo-virens* for the convex shape of the synnematic mitosporogenous zone and because of its smooth mitospores.

Keywords: *Myrothecium renaudii,* Heliconia.

RESUMEN

Myrothecium renaudii **sp. nov.** es descrita e ilustrada a partir de inflorescencias de *Heliconia psittacorum* x *H. spathocircinata* 'Golden Torch' y 'Tropic', colectadas en Venezuela. La nueva especie difiere de *M. atrum*, principalmente, por tener un sinema indeterminado, y de *M. flavo-virens* por la forma convexa de la zona mitosporógena del sinema y por poseer mitosporas lisas.

Palabras clave: *Myrothecium renaudii,* Heliconia.

Myrothecium Tode ex Fr. accomodates species with strong cellulolytic activity, mycotoxic and antibiotic action (Tulloch, 1972), and rhyzonic acid producers (Udagawa & Awao, 1984). *Myrothecium* species have been described in association with soil and living or decaying vegetal material (Tulloch, 1972; Agarwall, 1980; Rao & Hoog, 1983; Castañeda, 1985; Sutton, 1985; Matsushima, 1989; Castañeda & Kendrick, 1991), with calcified green algae (Dicosmo, Michaelides & Kendrick, 1980) and also, as endophytic fungi (Bohn, 1993). The genus also contains phytopathogenic species of economic importance as *M. roridum* on coffee (*Coffea arabica* L.) (Schieber & Zentmyer, 1968; Tulloch, 1972) and *M. mori* on mulberry (*Morus alba* L.) (Sullia & Padma, 1985).

A phytopathogenic species of *Myrothecium* isolated from inflorescences of *Heliconia psittacorum* x *H. spathocircinata* 'Golden Torch' and 'Tropic' from Venezuela (Escalona, Maciel y Renaud, 1992) is here regarded as new taxon.

Myrothecium renaudii Escalona **sp. nov.**
Figs.1-6

Etym: In honor of the venezuelan phytopathologist Juan Renaud, fond of ornamental plants and senior of the type specimen.

In matrice: Mycelium immersum hyalinum, ramosum, septatum, leve pariete, 2.5 - 7.25 µm. diametri; si superficialis, paucum. Mitosporomata synnematica indeterminata, partibus percurrentis accretionis aliisque productionis mitosporarum, aliquando aggregata, altitudine 96 - 490 µm. Setae absentes. Stromata subcuticularia, minime aucta, hyalina, angulari textura. Mitosporophora stricte compacta, ex superioribus stromatis cellulis formata, cylindrica, septata, levia, hyalina, accretionis indeterminatae, progresive magis magisque ramulosis versus superiorem partem, et 1 - 4 cellulis in apicibus ramorum, diametri 1.5 - 3.0 µm. Cellulae mitosporogenae integratae, solitariae vel in 2 - 4 verticillis, cylindricae, leves, hyalinae vel olivaceae, phialidicae, proliferatione percurrente. Mitosporae aggregatae in massa viscosa, convexa, initio hyalino - olivacea, deinde atra nitescenti; hyphis marginalibus hyalinis circumita, laxe intrincatis, septatis, sinuosis, rugosis, atque obtusis apicibus; unicellulares, ellipsoideae, aliquando cylindricae vel oblongae, rectae vel leviter curvatae, obtusis apicibus, basibus obtusis vel obconico-truncatis, leves, subhyalinae vel pallide-oleaceae, 7 - 19 x 3 - 6 µm.

In PDA: Coloniae singulares sparsae super cultionem, extensione ex dilutis conidiis obtentae; duodecim diebus incubitis 25 º C, diametrum 2 mm ferunt, mycelium paucum, plerumque immersum, septatum, ramosum, hyalinum, leve, diametri 1.5 - 7.5 µm et spurolatione massale, copiosa, oleiviridis coloris.

Typus: VENEZUELA, Valencia, Carabobo state; *in inflorescentiis vivis H. psittacorum* x *H. spathocircinata* 'Golden Torch' and 'Tropic' Aristiguieta (Heliconiaceae); September, 1991; Juan Renaud and Norberto Maciel; VIA 5987, holotypus. IMI, isotypus.

In host: Mycelium internal, branched, septate, hyaline, of smooth wall, 2.5 - 7.25 µm in diameter, scarce when superficial. Mitosporomata synnematic, indeterminate, with percurrent growth alternated with zones of mitospores production, ocasionally aggregated, 96 - 490 µm in height. Setae

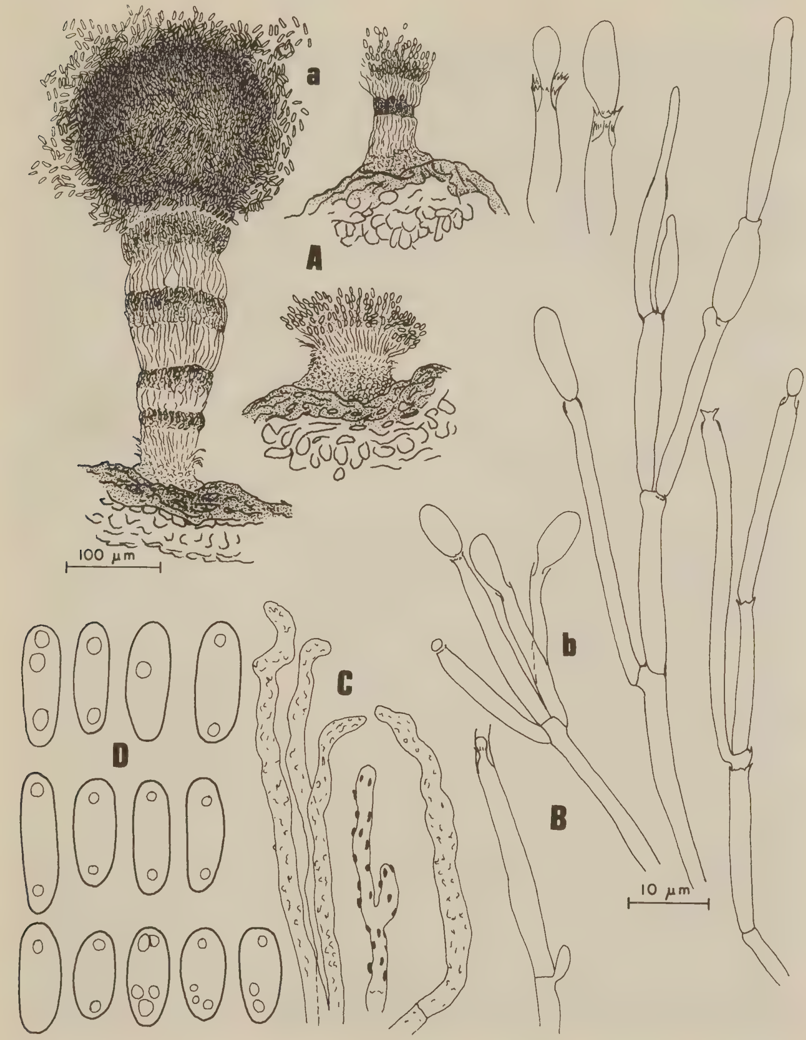
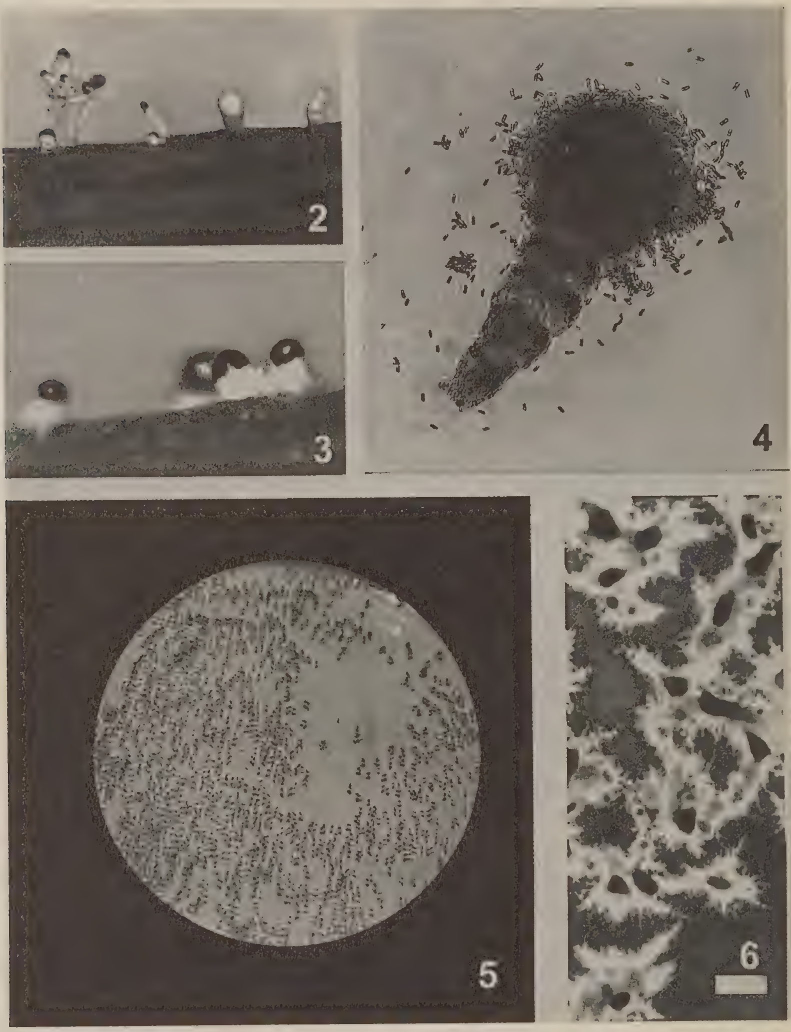


Fig. 1.- *Myrothecium renaudii*. A, synnematic mitosporomata at various stages of growth; a, mitosporoma with mass of mitospores at the apex. B, mitosporogenous cells and mitospores; b, whorl of mitosporogenous cells. C, marginal hyphae. D, mitospores.

absent. Stroma subcuticular, scarcely developed, hyaline, texture angularis. Mitosporophores narrowly compacted, originated on the upper



Figs. 2-6.- *Myrothecium renaudii*. 2,3, habit on *Heliconia psittacorum* x *H. spathocircinata;* 4, vertical section of a mitosporoma taken from natural substrate, 100X; 5, colonies on PDA; 6, detail of 5, (Bar scale = 1 mm).

stromatic cells, cylindric, septate, smooth, hyaline, of indeterminate growth, branching progressively towards the top and with 1 - 4 cells at the apical branches, 1.5 - 3.0 µm wide. Mitosporogenous cells integrated, solitary or in whorls of 2 - 4, cylindric, smooth, hyaline or olivaceous, phyalidic, of percurrent production. Mitospores aggregated into a viscous mass, convex, initially olivaceous-translucent, later bright black; surrounded by marginal hyaline hyphae, laxely entangled, septate, sinuous, rugose, apex obtuse; 0 septate, elliptical, sometimes cylindric or oblonge, straight or slightly curved, apex obtuse, base obtuse or obconic-truncate, smooth, subhyaline or pale olivaceous, 7 - 19 x 3 - 6 µm.

On PDA: Individual colonies scattered over the culture medium, obtained by the extension of mitospores dilution, and incubated at 25 ° C during 12 days, reached 2 mm diameter and showed scarce, inmerse, septate, branched, hyaline, smooth mycelium, 1.5 - 7.5 µm diameter, and with abundant mitospores, in olivaceous green mass.

DISCUSSION

Sutton (1985) described *M. flavo-virens* as ocassionaly having percurrent vegetative growth, similar to that in *M. renaudii.* However, this last species exhibits a distinctive convex mitosporoma in contrast with the cupulate mitosporoma in *M. flavo-virens.* Additionally, the two species differ in the mitospores, being smooth, subhyaline or pale olivaceous in *M. renaudii,* and brown, verruculose in *M. flavo-virens.*

M. renaudii is closer to *M. atrum* (Desm.) Tulloch because of the synnematic mitosporoma with warty or smooth marginal hyphae surrounding the mitospores mass and for the densely compacted mitosporophores carrying phyalides in whorls. Nevertheless, *M. renaudii* differs from *M. atrum* in having indeterminate mitosporophores, and subhyaline, elliptical mitospores.

Eleven additional species including *M. renaudii* have been described after the revision of the genus by Tulloch (1972). From these, *M. viride* (Agarwall, 1980) and *M. mori* (Sullia & Padma, 1985) may need to be reconsidered because, apparently, the introduction of these taxa was not supported by a thorough literature scanning. From the thirteen species recognized by Tulloch (1972) two were transferred into different anamorphic genera: *M. leucotrichum* (Peck) Tulloch to *Xepicula* as *X. leucotricha* (Peck) Nag Rag and *M. gramineum* Libert to *Xepiculopsis* as *X. graminea* (Libert) Nag Raj (Nag Raj, 1993). Consequently, only twenty two species are presently regarded as belonging into the genus *Myrothecium.*

ACKNOWLEDGEMENT

The author thanks to Dr. Ninoska Pons, for her valuable coments and suggestions, Dr. Richard Hanlin, for his collaboration in the preliminary identification of the *Myrothecium* material, and Dr. Angel Muñoz, for the latin description.

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THREE NEW SPECIES OF *HYPERPHYSCIA* (PHYSCIACEAE, LICHENIZED ASCOMYCOTINA), WITH A REVISIÓN OF *HYPERPHYSCIA ADGLUTINATA*

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Abstract*: *Hyperphyscia coronata *Scutari,* ***H. pseudocoralloides*** *Scutari and* ***H. cochlearis*** *Scutari are described as new species. The first taxon is unique within the genus by exhibiting apothecia with a crown of cilia and the thallus underside with well developed rhizinae. The second taxon resembles* ***H. coralloides*** *(Lynge) Scutari, but differs by the 1-septate spores. Except for the presence of soralia,* ***Hyperphyscia cochlearis*** *resembles* ***H. tuckermanii*** *(Lynge) Moberg. Likewise,* ***H. cochlearis*** *is quite similar in appearance to* ***H. variabilis*** *Scutari, a sorediate species with 3-septate spores. The thalli of* ***H. pseudocoralloides*** *and* ***H. coralloides*** *are comparatively analyzed. The occurrence of species with similar habit but different spore-types is discussed.* ***H. adglutinata*** *(Flörke) Mayrhofer & Poelt is also revised, and it appears to be a homogeneous, cosmopolitan species.*

INTRODUCTION

Hyperphyscia is a small genus in the Physciaceae characterized by the foliose, usually small, agglutinated, K- thalli, the paraplectenchymatous upper cortex, the indistinct, prosoplectenchymatous lower cortex and the production of filiform conidia. The underside lacks true rhizinae (sensu Poelt & Petutschnig 1992; see also Moberg 1977). The thallus is fixed by microscopic, irregular strands of hyphae, designated as hapters, which develop when contacting the substrate. Most species lack lichen substances. Zeorin, skyrin and some unknown pigments are the only products reported for the genus (Kashiwadani 1985, Moberg 1987, Scutari 1995).

As pointed out in an earlier paper (Scutari 1991), in ***Hyperphyscia*** the spores may be 1-septate (***Pachysporaria***-type), 3-septate (***Conradia***-type) or submuriform, and a correlation between the spore-type and geographical distribution is observed.

The present paper is part of the studies made at UPS. A revision of ***H. adglutinata*** (Flörke) Mayrhofer & Poelt, regarded as one of the most variable and widely distributed ***Hyperphyscia*** species (Thomson 1963; Poelt 1974; Moberg 1977, 1987; Galloway 1985; Kashiwadani 1985; Scutari 1995), is made. Three species are described as new to science: ***Hyperphyscia coronata***, with distinctly rhizinate underside and crown of cilia on the apothecia; ***H. pseudocoralloides*****,** similar in thallus habit to ***H. coralloides*** (Lynge) Scutari but producing 1-septate spores; and ***H. cochlearis***, a segregate from ***H. adglutinata*** s.l. The occurrence in ***Hyperphyscia*** of several pairs of species with similar thallus morphology but different type of spores is analyzed.

MATERIAL AND METHODS

Approximately 120 specimens were examined. Most material was provided by Dr. Roland Moberg, and is deposited in UPS and in Dr. Klaus Kalb's private herbarium (KALB), in Germany. Additional specimens examined are deposited in BAFC, H and S. Morphology was analyzed by dissecting, light and scanning electron microscopy (Scutari 1990). Sections were made by hand, and mounted in water or lactophenol cotton blue. Spot tests were performed with *K* (10% KOH aqueous solution) on the upper surface of the thallus and medulla. Chemical analyses were made following current TLC techniques (Culberson & Kristinsson 1970; Culberson 1972).

DESCRIPTION OF THE SPECIES

Hyperphyscia coronata **Scutari sp. nov.** (Figs. 1 a-c)

Thallus foliaceus, lobatus, propagulis vegetativis destitutus; superficies infera albida, rhizinis simplicibus, bene evolutis, pro parte visibili pagina supera; medulla alba. Apothecia corona ciliarum; sporae 1-septatae, typo ***Physcia***.

> Typus: *Peru, Dept. Ancash, Prov. Yungay, road Yungay-Llanganuco, ca. 22 km (road distance) NE of Yungay, 9° 5′ S, 77° 43′ E, 26-II-1981,* R. Santesson & R. Moberg P55:81 (UPS- holotypus).

Thallus foliose-lobate, corticolous, greyish with an olivaceous tinge, up to 2 cm diam., seemingly larger when confluent with other thalli, upperside smooth, epruinose; with no vegetative propagules. Lobes linear to flexuose, plane, slightly imbricate to discrete, (0.4-)0.7-1.2(-2.4) mm width. Underside whitish, rhizinae sparse but well developed, concolorous with the lower surface to black, often projecting beyond the margins. Upper cortex paraplectenchymatous, medulla white, lower cortex prosoplectenchymatous, indistinct. Apothecia up to 1.7 mm diam., margins entire, mostly bearing a crown of cilia; spores mostly of the ***Physcia***-type, 17.6-20.9 x 8.8-9.9 µm. Pycnidia and conidia as in the genus. *Chemistry*: upperside and medulla K-; no lichen substances (TLC).

Remarks: ***Hyperphyscia coronata*** is so far unique within the genus because of its apothecia with a crown of rhizina-like structures (cilia) and the underside with true rhizinae (in the sense of Poelt & Petutschnig 1992), eventually visible from the upper surface at the margin of the lobes. Further comments are given in the Discussion.

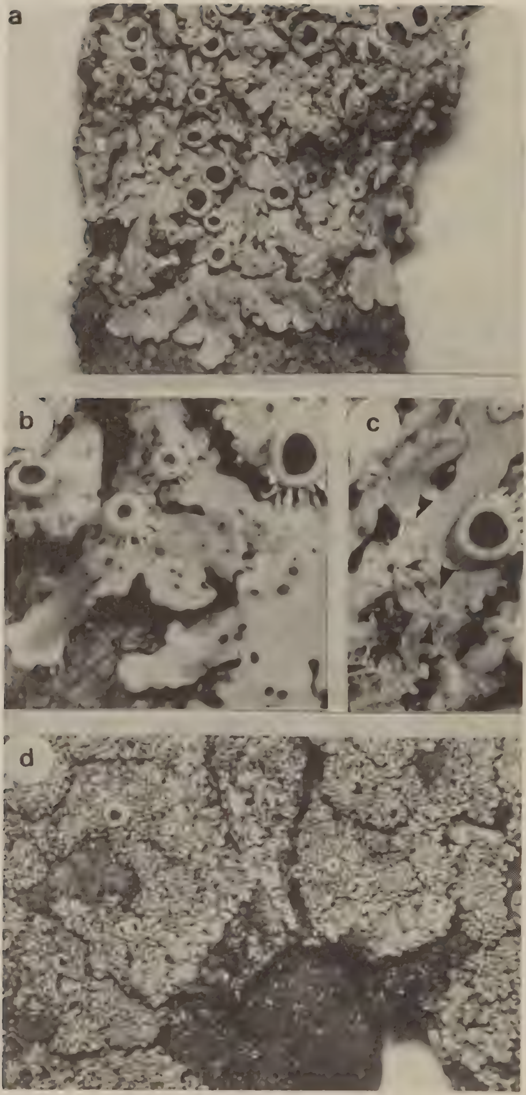

Fig. 1. a-c. ***Hyperphyscia coronata*** Scutari (holotype). **a.** Habit (x 6). **b-c.** Details showing the crown of cilia and the rhizinae partly projecting beyond the lobe margins (arrows; x 10). **d.** ***Hyperphyscia pseudocoralloides*** Scutari, habit (holotype; x 10).

Hyperphyscia pseudocoralloides **Scutari sp. nov.** (Figs. 1 d; 2; 4 c-d)

Thallus minutus, indistincte foliaceo-lobatus, coralloides; lobi angusti, raro usque ad 0.4(-0.5) mm lati, pro parte adnati, pro parte ascendentes, margines loborum structuris granularibus instructi. Differt ***Hyperphyscia coralloides*** sporis 1-septatis.

> Typus: *BRAZIL. Sao Paulo, Bezirk Rio Claro, etwa 2 km westlich von Rio Claro, 650 m, 31-V-1980*, leg. K. Kalb & M. Jorge (KALB-holotypus, isotypus).

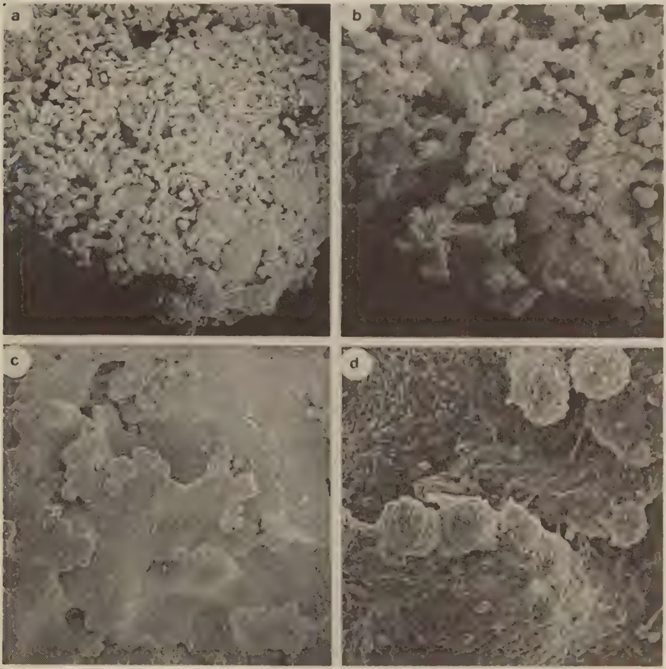

Fig. 2. *Hyperphyscia pseudocoralloides* observed with SEM (holotype). **a.** A densely granulate portion of the thallus (x 22). **b.** Granules along lobe margins (x 55). **c.** Initial stages of development of marginal granules (x 55). **d.** Detail showing the similar texture of upper surface and granules (x 280).

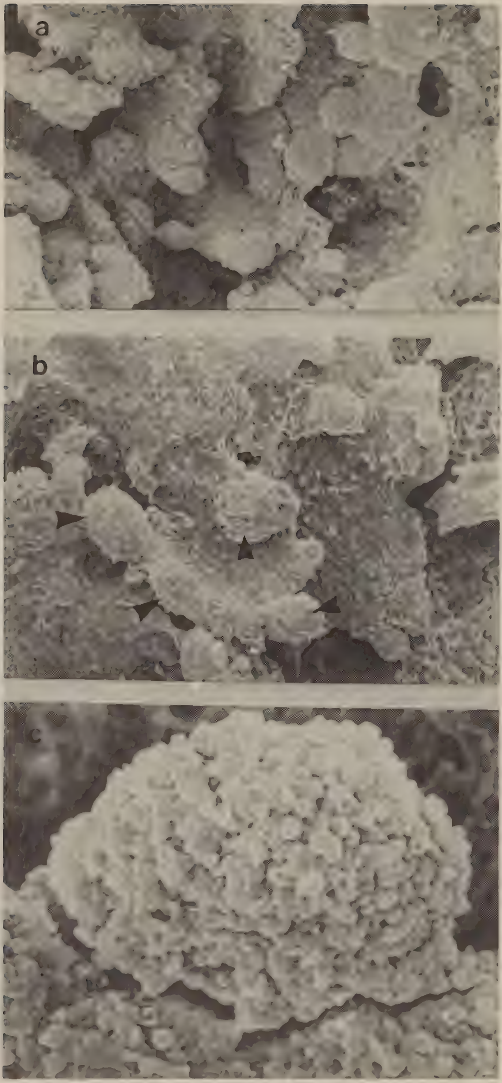

Fig. 3. ***Hyperphyscia coralloides*** (Lynge) Scutari, thallus morphology observed with SEM (BAFC 36678). **a.** Ascending to suberect lobes (x 150). **b.** Lobe with marginal granular structures (x 200). **c.** Detail of a granule separating from the lobe (x 1000).

Thallus minute, foliose-lobate, corticolous, irregular by coalescence with other thalli. Lobes indistinct, partly plane, closely appressed and adnate, very narrow, rarely up to 0.4(-0.5) mm wide, contiguous to slightly imbricate; partly ascending, with marginal, granular to coralloid "isidia". Underside, as far as visible, black, without rhizinae. Apothecia scarce, up to 1.3 mm diam., margins entire, irregularly crenate, or indistinct, dissolved into granules; spores 1-septate, of ***Pachysporaria***-type, 16.0-20.0(-23.0) x 8-10(-11) µm. Pycnidia not seen. *Chemistry*: upperside and medulla K-; no substances detected (TLC).

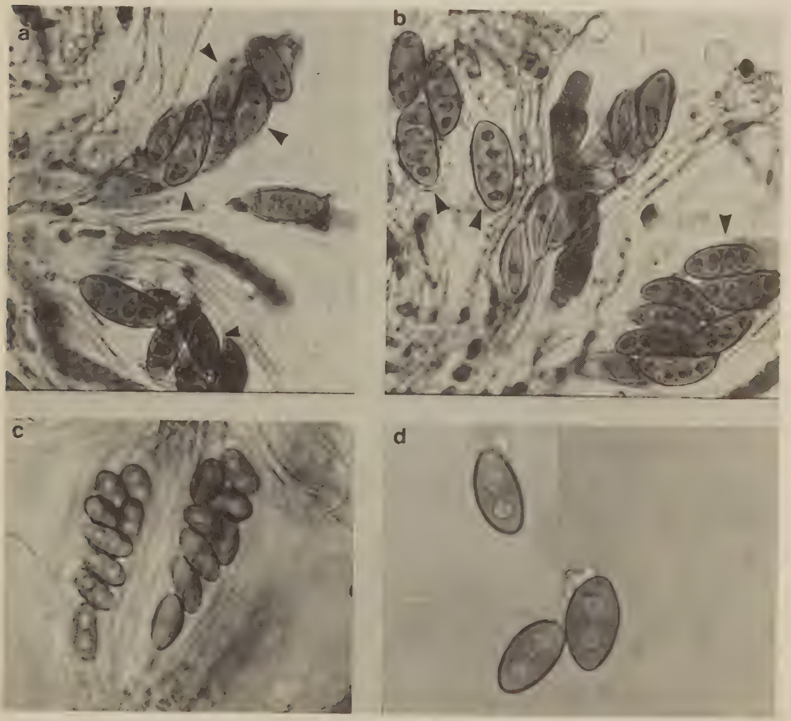

Fig. 4. a-b. Spores of the ***Conradia***-type in ***Hyperphyscia coralloides*** (holotype; x 630). **a.** Asci with young, 1-septate and 3-septate spores (arrows). **b.** Young, unicellular spores (center), and mature, 3-septate spores (arrows). **c-d.** Spores of the ***Pachysporaria***-type in ***Hyperphyscia pseudocoralloides*** (holotype). **c.** Asci with mature spores (x 400). **d.** Detail of mature spores (x 630).

Remarks: ***H. pseudocoralloides*** is close to ***H. coralloides*** in thallus morphology (Figs. 2, 3). Both species exhibit a minutely lobate, coralloid thallus with narrow lobes and granular structures on lobe margins, which are similar to marginal isidia. As observed in Fig. 3c, they can separate easily from the thallus and function as propagules. The new species, however, is distinguished by the 1-septate spores, whilst ***H. coralloides*** exhibits 3-septate spores (***Pachysporaria***-type sensu Esslinger 1978, and ***Conradia***-type sensu Krenn 1994, respectively; Fig. 4).

Representative specimens examined: Sterile material of the *H. coralloides-pseudocoralloides complex: ARGENTINA. Buenos Aires Province: Pdo. Gral. Pueyrredón, Laguna de los Padres, on bark of* ***Pinus*** *sp., 27-III-1988, leg. N. Scutari, BAFC 36679. Córdoba Province: Dpto. Río Cuarto, Río de los Sauces, on bark of* ***Morus*** *sp., Febr. 1986, leg. M. Bertoni, BAFC 36330.* *Hyperphyscia coralloides: ARGENTINA. Buenos Aires Province: Pdo. Ensenada, Punta Lara, en las cercanías del camino a Villa Elisa, on bark of* ***Fraxinus*** *sp., 17-VI-1984,* leg. P. Ranta, BAFC 35884a. *Pdo. Gral. Pueyrredón, Laguna de los Padres, on bark of* ***Pinus*** *sp., 27-III-1988,* leg. N. Scutari, BAFC 36678. *BRAZIL. Rio Grande do Sul: Pelotas, ad* ***Solanum*** *sp., loco humido, 22-XII-1892,* G. Malme 859C (S-holotype).

Hyperphyscia cochlearis **Scutari sp. nov.** (Fig. 5 a-b)

Thallus foliaceus, distincte lobatus, plus minusve laxe adnatus; lobi 0.4 mm usque ad 3.5 mm lati, apicibus saltem pro parte cochlearibus; soralia capitata, submarginalia vel marginalia, raro laminaria. Ascosporae 1-septatae, typo ***Pachysporaria***. Differt ***Hyperphyscia tuckermanii*** lobis soraliis, et ***H. variabilis*** ascosporis 1-septatis.

> *Typus: BRAZIL. Sao Paulo, Serra das Contas, oberhalb von Socorro, etwa 130 km nördlich von Sao Paulo, 800 m, 15-IV-1979,* leg. K. Kalb & G. Plöbst (KALB-holotypus).

Thallus foliose, distinctly lobate, ± loosely adnate, rarely orbicular, up to 2 cm diam., usually irregular, coalescent with other thalli forming larger patches, upperside greyish green to brownish grey, smooth, epruinose. Lobes imbricate, apices of variable width (0.4-3.5 mm), rounded, sometimes deeply incised,

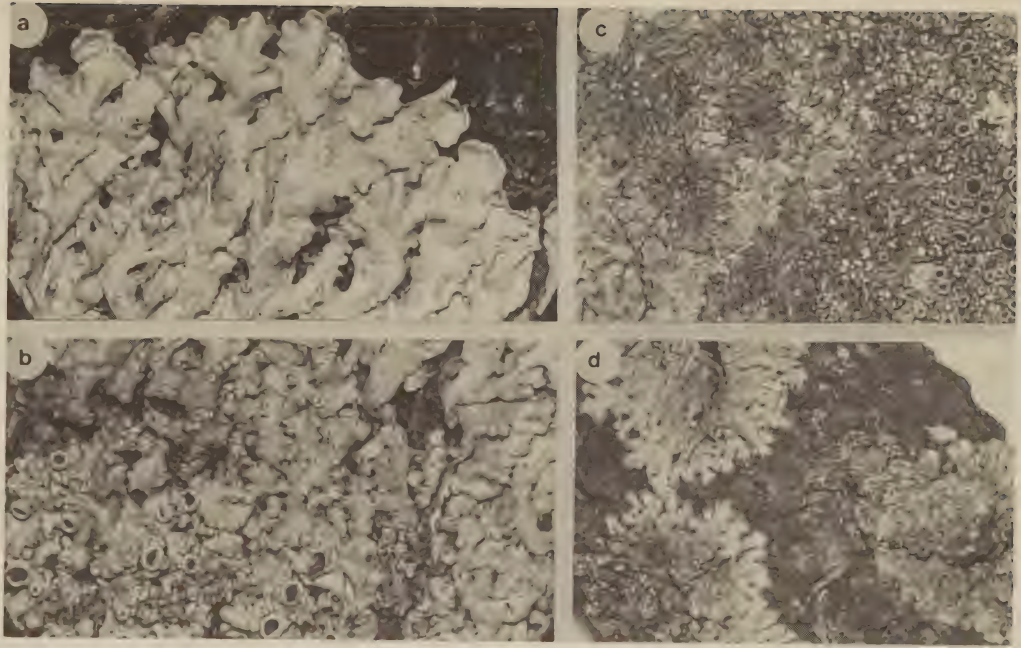

Fig. 5. a-b. ***Hyperphyscia cochlearis*** Scutari, peripheral and central part of the thallus, respectively (holotype; × 6). **c-d.** ***Hyperphyscia adglutinata*** (Florke) Mayrhofer & Poelt, habit. **c.** × 6 (England, Gloucester, UPS s.n.). **d.** × 10 (Italy, Lombardía, Pavia, UPS s.n.).

at least partly concave, spoon-shaped. Soralia capitate, submarginal to marginal, rarely laminal, mostly scattered, sometimes covering central parts; soredia granular. Underside whitish to blackish, rhizinae absent. Upper cortex paraplectenchymatous, medulla white, lower cortex prosoplectenchymatous, indistinct. Apothecia ± sparse, up to 1 mm diam., margins entire, spores 1-septate, of ***Pachysporaria***-type, 19.5-23.7 x 9.7-10.8 µm. Pycnidia ± sparse, pycnoconidia as in the genus. *Chemistry*: upperside and medulla K-; lichen substances absent (TLC).

Remarks: ***H. cochlearis*** is characterized by the robust, loosely adnate thallus, the lobes with spoon-shaped apices of variable width, the capitate, submarginal to marginal soralia, the white medulla, and the 1-septate spores. The new species is clearly distinguished from ***H. adglutinata*** (see below). ***H. cochlearis*** is closely related to ***H. tuckermanii*** in thallus habit, and is regarded here as its sorediate counterpart. When sterile, the new taxon is quite difficult to separate from ***H. variabilis***, a species also similar in appearance but producing 3-septate spores. ***H. cochlearis*** grows on bark intermixed with hepatics (Jungermanniales), mosses and other lichens.

Specimens examined: *ARGENTINA. Buenos Aires Province: Martín García Island, Cemetery, on bark of* ***Cupressus*** *sp., 9-VIII-1987,* leg. N. Scutari, BAFC 36482. *Córdoba Province: Punilla Department, La Cumbre, Balneario El Chorrito, on* ***Salix*** *sp. growing on a slope by the river, 20-XI-1992,* leg. N. Scutari, BAFC 37519, 37520 and 37521. *BRAZIL. Sao Paulo: bei Ruilandia, etwa 20 km südwestlich von Sao José do Río Preto, an der Rinde verschiedener Laubbäume in einem Cerradao, 450 m, 13-X-1979,* leg. K. Kalb & G. Plöbst (KALB); *Jaraguá, an Rinde am Westhang, ca. 1000 m, 8-XI-1975, H. Schindler 5636 (UPS). KENYA. Rift Valley, ca. 9 km N of Kongoni, at road close to the lake W of lake Naivasha, 0° 44′ S, 36° 17′ E, 2000 m, 21-II-1979,* R. Moberg 4479a (UPS). *SOUTH AFRICA. Natal Province: Umgeni distr., on oak, 29-IX-1929,* leg. Höeg (UPS).

Additional specimens examined: Hyperphyscia tuckermanii: *BRAZIL. Rio Grande do Sul: Santo Angelo, Serra Pellados,* G. Malme 952 (S-holotype; UPS-isotype). *Rio de Janeiro: Serra Mantiqueira, Itatiaia, zwischen Registro do Picú und Agulhas Negras, on bark, 23-VII-1979,* leg. K. Kalb & G. Plöbst (KALB). *Sao Paulo: An der Strasse zwischen Socorro und Aguas* *de Lindóia, etwa 150 km nördlich von Sao Paulo, an Alleebäumen, 15-IV-1979,* leg. K. Kalb & L. Assis (KALB). Hyperphyscia variabilis: *BRAZIL. Rio Grande do Sul: Taim Ecological Station, on bark of* ***Ficus organensis****, 13-XII-1986,* M. Fleig 2992 (H-holotype).

***Hyperphyscia adglutinata* (Flörke) Mayrhofer & Poelt.**
In Hafellner et al., *Herzogia* **5:** 62 (1979). ***Lecanora adglutinata*** Flörke, *Deutsch. Lich.:* 7 (1819). Type: Germany. Berlin, Flörke s. n. (lectotype: PC!). ***Physciopsis adglutinata*** (Flörke) Choisy, *Bull. Mens. Soc. Linn. Lyon* **19:** 20 (1950).
(Fig. 5 c-d)

Thallus lobate, closely appressed, agglutinate, ± orbicular, up to 1-2 cm diam., usually coalescent with other thalli, upperside brownish green to brownish, smooth, epruinose, usually with no hypothallus. Lobes linear, flat, discrete to imbricate, dichotomously to subdichotomously branched, frequently distinct from the centre of the thallus, sometimes with darker margins, narrow, rarely up to 0.4-0.5 mm width, apices truncate to rounded and slightly broadened. Soralia orbicular, crateriform to ± capitate, isolated to coalescent, originated from small, laminal to submarginal or subapical protrusions, eventually reaching margins by further development; in herbarium material frequently eroded. Apothecia rare, up to 1.4 mm diam., margins entire, discs blackish brown, spores 1-septate, of ***Physcia***- to ***Pachysporaria***-type, (14.0-)15.0-17.9(-20.5) x (6.5-)7.3-9.2 (-10.8) µm. Pycnidia and conidia as in the genus. *Chemistry*: upperside and medulla K-; no lichen substances detected (TLC).

Remarks: ***H. adglutinata*** is a very distinct, cosmopolitan taxon. It is clearly distinghuished from ***H. cochlearis*** by the agglutinated, small, usually brownish thallus, the narrow, flat lobes with truncate to slightly broadened apices, and the soralia, mainly laminal in origin. It is to be enphasized that most of the atypical specimens at UPS referred to as ***H. adglutinata*** belong to ***H. cochlearis***. Additional comments are given in the Discussion.

Representative specimens examined: *ARGENTINA. Buenos Aires Province: Río de la Plata, Martín García Island, on bark of* ***Erythrina crista-galli****,* leg. N. Scutari, *BAFC 36055. CHINA. Yunnan: Kunming, Anning Co., Hot Springs (30 km SW of Kunming), along the road to the Caoxi Temple, 24° 48′ N, 102° 27′ E, alt. 1800 m, on* ***Salix*** *sp. and* ***Fraxinus chinensis****, 28-IX-1987,* R. Moberg 8156 (UPS). *DOMINICAN REPUBLIC. Puerto Plata Province: Sosúa, El Batey, 0.8 km S of Playa Chiquita, on* ***Citrus aurantifolia*** *in abandoned plantation in cattle pasture, 6-I-1991,* T. Ahti 49411 (H). *ECUADOR. Azuay: etwa 10 km südlich von Paute und 6 km nördlich von Gualaceo, an alten Einzelbäumen, alt. 2300 m, 27-VIII-1987,* K. Kalb 19532 (KALB). *ENGLAND. Gloucester, Cirencester, 1874,* leg. Josuah (UPS). *ITALY. Lombardia, Pavia, on the southern side of the river Ticino, near Canal Gravellone, on* ***Populus canadensis*** *in dense cultivated forest, 8-V-1953,* leg. R. Santesson (UPS). *KENYA. Rift Valley, Lake Nakuru National Park, at an escarpment close to the southern end of the lake Elmenteita, 0° 29′ S, 36° 16′ E, 1900 m, on twigs, 20-II-1979,* R. Moberg 4466a (UPS). *ROMANIA. Dobrogea: Tulcea, Caraorman village, on a solitary tree (Populus sp.), 45° 04′ N, 29° 24′ E, alt. 20 m, 5-X-1992,* R. Moberg 10131 (UPS). *SOUTH AFRICA. Cape Province: Div. Paarl, Groot Drakenstein, on* ***Quercus*** *sp. at roadside, 11-VIII-1953,* O. Almborn 2003 (UPS). *SPAIN. Asturias, Covadonga, S of the Santuario, alt. 500 m, on the trunk of an* ***Acer pseudoplatanus*** *by the road, 30-V-1959,* R. Santesson 13082 (UPS). *SWEDEN. Bohuslän: Solberga par., the churchyard. 57° 56′ N, 11° 49′ E, on* ***Ulmus*** *sp., near the base, 12-VIII-1933,* H. Magnusson 14088 (UPS). *U.S.A. California, San Mateo Co.: 10 km SSW of San Mateo, along Skyline Blvd., alt. 100 m, on twigs and branches of* ***Baccharis*** *sp., 10-IX-1977,* L. Tibell 7647 (UPS).

DISCUSSION AND CONCLUSIONS

Hyperphyscia coronata is a very distinct species. At first glance, it resembles a member of the genus ***Phaeophyscia*** because of thallus habit and the apothecia with a crown of cilia. Although known only from the type material, I have found it important to describe this taxon as it calls our attention to the need of broadening our concept of ***Hyperphyscia***. ***H. coronata*** is the only known species of ***Hyperphyscia*** with crowned apothecia. The distinctly rhizinate underside is the other remarkable feature. The new species (along with ***Physcia coronifera*** Moberg - Moberg 1990), is also interesting as an example to show that, within the Physciaceae, the presence of crowned apothecia is not exclusive of the genus ***Phaeophyscia***.

H. pseudocoralloides is similar in thallus habit to ***H. coralloides*** but differs by the production of 1-septate spores (cfr. Figs. 2-4). The spore-type has been used widely as an important taxonomic character in the Physciaceae since the work of Malme (1902). In connection with infrageneric arrangements in the genus ***Rinodina***, he described four types of spores, taking into account features of wall thickening as well as the number of septa. Subsequently, more spore-types were added. Kurokawa (1962) subdivided the genus ***Anaptychia*** s.l. (including ***Heterodermia*** Trevisan) by correlating the spore-type with some distinct vegetative characters. Poelt (1965) introduced the use of spore features for generic delimitation. Up to seventeen types of spores have been distinguished in the Physciaceae (Mayrhofer 1982), most of them differing only in wall thickening. However, now we know a number of species in ***Hyperphyscia***, ***Phaeophyscia***, ***Physcia*** and ***Rinodina*** which show some variation regarding this character (cfr. Moberg 1986, 1987, 1993; Giralt et al. 1994). The present tendency is to pay attention to the ontogeny of spores: it has proved to be relevant at the time of evaluating the importance of the number of septa, and appears as a constant character at the species level. Scheidegger (1987: 11) reported 3-5 septa in comparatively old spores of some saxicolous ***Buellia***. However, additional septa were secondarily formed, much thinner than the first one; therefore, the variability in the number of septa was accepted within the range of variation of each species. Krenn (1994: 15) distinguished four ontogenetic series which were found to be relevant for the distinction of species in the ***Rinodina conradii*** group. A number of cases were reported in ***Rinodina*** where species with similar thallus are distinguished by spore features as most important or even unique distinctive characters (cfr. Matzer & Mayrhofer 1994; Giralt et al. 1994). Observations on the ontogeny of 3-septate spores of ***Hyperphyscia*** revealed that, initially, young spores are unicellular (Fig. 4b), then 1-septate, and finally 3-septate (Fig. 4a), mature spores being always 4-celled (Fig. 4b). In conclusion, the number of septa is regarded here as a good character for distinction of species.

The occurrence of pairs of species with similar thallus features but with 1-septate or 3-septate spores appears as a frequent phenomenon within ***Hyperphyscia***. Three of such pairs can be mentioned: ***H. syncolla*** (Tuck.) Kalb - ***H. viridissima*** (Müll. Arg.) Scutari; ***H. cochlearis*** - ***H. variabilis***; and ***H. pseudocoralloides*** - ***H. coralloides***. According to our present knowledge, there is no possibility of distinction between the members of a given pair when dealing with sterile specimens.

As mentioned above, ***Hyperphyscia adglutinata*** was considered as a variable, widely distributed species. Close examination of abundant material with 1-septate spores, orbicular soralia and white medulla, mainly from Europe, South America and Africa, revealed the existence of at least two distinct taxa, ***H. adglutinata*** s. str. and ***H. cochlearis***.

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THE LICHEN GENUS *RINODINA* IN BELGIUM, LUXEMBOURG AND THE NETHERLANDS

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ABSTRACT: The morphology, anatomy, chemistry, ecology and distribution of twenty-three *Rinodina* species present in the Netherlands, Belgium and Luxembourg are discussed. This includes *R. archaea, R. aspersa, R. atrocinerea, R. bischoffii, R. calcarea, R. confragosa, R. conradii, R. dubyana, R. efflorescens, R. gennarii, R. griseosoralifera, R. immersa, R. interpolata, R. lecanorina, R. occulta, R. oleae, R. oxydata* (incl. *R. vezdae*), *R. pityrea, R. pyrina, R. sicula, R. sophodes, R. teichophila* and *R. tunicata*. New data on the chemistry of *R. sicula* are given. Some illustrations, distribution maps and a key to the species are provided.

INTRODUCTION

According to the literature checked, *Rinodina* species have rarely been collected in Belgium, Luxembourg and the Netherlands (= the Benelux).
Concerning the Netherlands, only four species, *Rinodina conradii, R. horiza* var. *albana* (= *R. albana*), *R. metabolica* α *exigua* (= *R. exigua*) and *R. sophodes*, collected during the period 1840-1895, are mentioned by ABELEVEN (1898). A re-examination of one specimen of *R. exigua* and one of *R. sophodes* has shown that both correspond to *R. oleae.* The specimens reported as *R. conradii* and *R. albana* could not be examined.
The checklist of the Netherlands (BRAND & al. 1988) mentions eight *Rinodina* species (*R. bischoffii, R. calcarea, R. conradii, R. efflorescens, R. exigua, R.*

oxydata, R. pyrina and *R. teichophila*) of which *R. exigua* was the most problematical taxon. Most of the specimens identified as *R. exigua* were incorrectly determined and appear to belong to *R. gennarii* or *R. oleae*. The recent additions to the checklist of the Netherlands (v.d. Boom & al. 1994a) include three new records of *Rinodina, R. aspersa, R. colobina* and *R. sophodes*. However, the records of *R. colobina* refer to the closely related *R. pityrea*, the only species which is known to be corticolous as well as saxicolous in the Benelux.

From Belgium, *R. atrocinerea, R. bischoffii, R. exigua, R. ocellata* (= *R. lecanorina*), *R. subexigua* (= *R. gennarii*) and *R. teichophila* are reported by Lambinon (1969). In more recent publications, *R. aspersa, R. atrocinerea, R. badiella* (= *R. tephraspis*), *R. calcarea, R. dubyana, R. efflorescens, R. immersa, R. interpolata, R. lecanorina, R. oxydata* and *R. tunicata* are also mentioned (Sérusiaux & al. 1983, Sérusiaux & Rose 1984, Mayrhofer 1984a, Diederich & al. 1988, 1992, Mayrhofer & al. 1990, 1992). According to our observations, the record of *R. tephraspis* (= *R. badiella*) does not correspond to this species. *R. tephraspis* is characterized by containing zeorin and usually the gyrophoric acid complex and possessing *Pachysporaria*-type ascospores, whereas the specimen reported by Diederich & al. (1988), Mayrhofer (1984a) and Mayrhofer & al. (1992) contains atranorin and has typical ascospores intervening between the *Physcia*- and the *Pachysporaria*-type. The record of *R. calcarea* in Sérusiaux & al. (1983) refers to *R. tunicata,* those of *R. exigua* in Lambinon (1969) to *R. oleae* and, according to Sérusiaux (pers. comm.), that of *R. aspersa* in Diederich & al. (1988) to *Fuscidea praeruptorum*.

Four corticolous and three saxicolous *Rinodina* species have previoulsy been reported from Luxembourg: *R. archaea, R. efflorescens, R. griseosoralifera* and *R. pyrina* (Diederich 1989, Diederich & al. 1991) and *R. gennarii, R. interpolata* and *R. oxydata* (v.d. Boom & al. 1994b), respectively. According to our observations, the record of *R. interpolata* refers to *R. sicula.*

Most important substrata for saxicolous *Rinodina* species in the Benelux are natural rocks, concrete, mortar, brick, basalt and granite. In the Netherlands and western Belgium granite and basalt are especially well represented in the dikes situated along the sea and the rivers. The specimens from the Netherlands were collected mostly on brick walls of dikes and on the natural calcareous outcropping rocks of the extreme southeast of the country.

Belgium and Luxembourg are richer in natural rocks which are mainly present in the higher ground where peaks rise gently from an upland that extends southeastwards including highest points of c. 700 m in Belgium and

c. 550 m in Luxembourg. Schistose rocks as well as limestone outcrops are very common throughout central Belgium.

Concerning the corticolous and lignicolous *Rinodina* species, only *R. oleae* and *R. efflorescens* seem to be common in the Benelux. Whereas the former is widely distributed throughout the Netherlands and Belgium, where it occurs on many different phorophytes such as *Acer, Aesculus, Betula, Juglans, Quercus, Salix, Populus* and *Ulmus,* as well as on wood, the second is mainly present in Luxembourg where it grows preferently on *Quercus robur.* All other corticolous *Rinodina* species reported from the studied area are known only from a few localities (*R. conradii, R. griseosoralifera*, *R. pityrea* and *R. pyrina*) or even from a single one, as is the case of *R. archaea* and *R. sophodes*. The later taxon was collected in one of the most unpolluted areas of the Netherlands (Waddensea island Vlieland).

In all, the lichen genus *Rinodina* is represented by twenty-three species in the Benelux, of which fourteen species are known from the Netherlands, sixteen from Belgium and nine from Luxembourg. Among them, only the saxicolous *R. gennarii* and the corticolous *R. oleae* seem to be common and ±widely distributed.

One additional species, previously reported by DIEDERICH & al. (1988), MAYRHOFER (1984a) and MAYRHOFER & al. (1992) as *R. tephraspis* (= *R. badiella*), could not be identified.

Finally, the specimen of *R. albana* (= *R. horiza* var. *albana*) reported by ABELEVEN (1898) has not been examined. For this reason this taxon is not included in the present contribution.

CHARACTERS OF THE SPECIES

The ascospores of the species treated in this paper belong to ten different types: the *Conradii*-type in *Rinodina conradii* (Fig.1A); the *Dirinaria*-type in *R. gennarii* and *R. oleae* (Fig.1Ba-b); the *Tunicata*-type in *R. pityrea, R. calcarea* and *R. tunicata* (Fig.1C, 2Aa-b); the *Bischoffii*-type in *R. bischoffii* and *R. immersa* (Fig.2C); the *Bicincta*-type in *R. lecanorina* (Fig.2D); the *Physcia*-type in *R. confragosa, R. interpolata* and *R. occulta* (Fig.3A-B); the *Milvina*-type in *R. sophodes*; the *Physconia*-type (including *Sicula*- and *Dubyana*-type) in *R. archaea, R. dubyana, R. pyrina* and *R. sicula* (Fig.2B, 3C); the *Pachysporaria*-type in *R. atrocinerea* (Fig.3D) and the *Mischoblastia*-type in *R. oxydata* (incl. *R. vezdae*) and *R. teichophila* (Fig.4A, Ba-b).

All the present species have ascospores which originate via a type A ontogeny (e.g. Fig. 2B-D, 3A-D, 4A), except for *R. gennarii, R. oleae*, *R.*

conradii and *R. pityrea,* where the ascospores follow a type B ontogeny (e.g. Fig. 1A-C): in young ascospores, the septum is inserted after the formation of apical wall-thickenings (compare GIRALT 1994; GIRALT & MAYRHOFER 1995). Two species, *R. calcarea* and *R. teichophila*, have an ascospore-ontogeny which is somewhat intermediate between the types A and B, with some young ascospores where the septum is inserted before apical wall-thickenings and with some young ascospores where it is inserted after apical wall-thickenings become distinct (Fig. 2A, 4B).

Only three of the species considered are sorediate and normally sterile, viz. *Rinodina aspersa, R. efflorescens* and *R. griseosoralifera,* while *R. pityrea* is blastidiate but often fertile.

The asci are of typical *Lecanora*-type (HONEGGER 1978) in all species treated but often show tendencies towards the *Bacidia*-type in *R. oxydata* s. lat. (RAMBOLD & al. 1994).

The apothecia are pseudolecanorine from the beginning (DUGHY 1952, CLAUZADE & ROUX 1985, GIRALT 1994) in *R. immersa* and *R. dubyana,* lecanorine but usually becoming pseudolecanorine in *R. interpolata, R. occulta*, *R. oxydata* s. lat. and *R. tunicata,* and cryptolecanorine (SHEARD 1967) in *R. lecanorina* rather than typically lecanorine as occurs in the other species considered.

The following lichen compounds have been detected in the present species by TLC: atranorin (with ±chloratranorin), pannarin (with several related unidentified compounds), gyrophoric acid (with ±lecanoric, orsellinic, umbilicaric and 5-*0*-methylhiascic acids) and zeorin.

MATERIAL AND METHODS

Approximately 280 collections from various herbaria, including several recent collections made during this study, have been examined. For the specimen citations the following collector abbreviations have been used: AA = A. Aptroot; HS = H. Sipman; MB = M. Brand; PB = P.v.d. Boom and PD = P. Diederich. The material is kept in their private herbaria.

All morphological descriptions are based on our personal examinations. Current mycological terminology has been employed and generally follows that of HAWKSWORTH & al. (1995). The terminology used for the asci follows that of HONEGGER (1978) and RAMBOLD & al. (1994), while for the ascospore-types the terminology of MAYRHOFER (1982), SCHEIDEGGER (1993), GIRALT (1994), GIRALT & MAYRHOFER (1995) and MATZER & MAYRHOFER (1996) is followed.

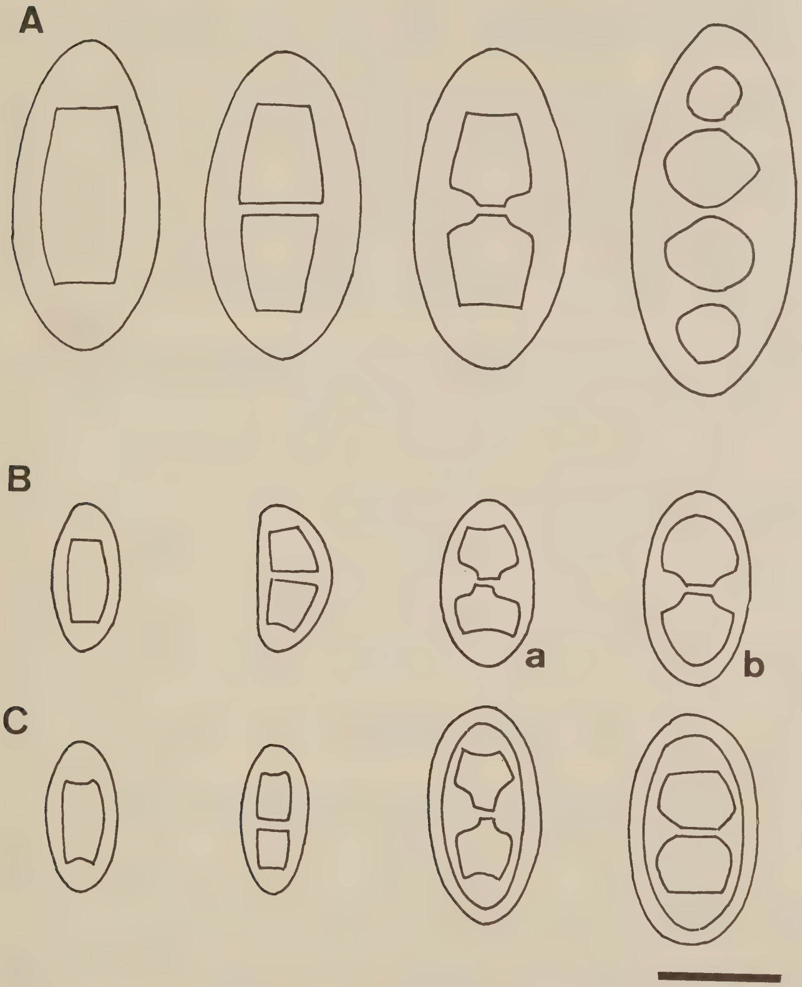


Fig. 1.- A-C: Ascospore ontogeny of type B: **A.** *Conradii*-type ascospores of *R. conradii* (MB-27027). **Ba-b.** *Dirinaria*-type ascospores of *R. gennarii* (PB-5628): **a)** typical *Dirinaria*-type ascospore; **b)** grading into the *Physconia*-type. **C.** *Tunicata*-type ascospores of *R. pityrea* (MB-17713).

Chemical data afforded usually refer to specimens from the Benelux. When those data have been taken out from the literature, the sources are given. The standardized methods of thin layer chromatography (TLC) were employed (e.g. Culberson & Ammann 1979; Culberson & al. 1981; Culberson & Johnson 1982) for the identification of lichen substances.

As most of the species considered have previously been described in detail in other revisional treatments, including those of Sheard (1967, 1973), Mayrhofer & Poelt (1979), Mayrhofer (1984a), Mayrhofer & al. (1990), Fox & Purvis (1992), Matzer & Mayrhofer (1994, 1996), Giralt & Mayrhofer (1995), Giralt & Barbero (1995), Giralt & al. (1994, 1995) and Ropin & Mayrhofer (1993, 1995), the descriptions given here emphasize characters of value for species identification but do not repeat features common to all species.

Notes on the ecology and distribution of the species usually only refer to the studied area.

KEY TO THE SPECIES

1 On soil, mosses, bark or wood. **2**

1* On rocks. **9**

2 Thallus sorediate, with delimited soralia, usually sterile. **3**

2* Thallus not sorediate, usually fertile. **4**

3 Soredia greenish to yellowish, PD+ orange (pannarin present), K- (atranorin absent). ***R. efflorescens***

3* Soredia withish to blue-grey, PD- or PD+ faintly yellow (pannarin absent), K+ yellow (atranorin present). ***R. griseosoralifera***

4 Mature ascospores *Conradii*-type, with four lumina, 25-31 x 10-15 µm. ***R. conradii***

4* Mature ascospores different, with two lumina, smaller. **5**

5 Epihymenium blue-grey, K+, C+ and N+ violet. Thallus leprose (entirely blastidiate). Ascospores *Tunicata*-type, with a thick outer wall, 14-21 x 7-12 µm.
R. pityrea

5* Epihymenium brown, K-, C- and N-. Thallus not leprose (not entirely blastidiate). Ascospores different.
6

6 Ascospore-ontogeny of type B. Ascospores *Dirinaria*-type, 13-18 x 6-9 µm.
R. oleae

6* Ascospore-ontogeny of type A. Ascospores different.
7

7 Ascospores *Milvina*-type, constricted at the septum. Prothallus present, black. Apothecial cortex thick, I+ strongly blue.
R. sophodes

7* Ascospores *Physconia*-type, not constricted at the septum. Prothallus absent. Apothecial cortex thin, I- or I+ faintly blue.
8

8 Ascospores 16-22 x 7-11 µm, torus present.
R. archaea

8* Ascospores smaller, 12-15 x 5-7 µm, torus absent or poorly developed.
R. pyrina

9 Thallus or at least medulla C+ red (gyrophoric acid present).
10

9* Thallus C- (gyrophoric acid absent).
12

10 Thallus sorediate. Apothecia usually absent.
R. aspersa

10* Thallus not sorediate. Apothecia usually present.
11

11 Ascospores *Pachysporaria*-type. Thallus K+ yellow (atranorin present).
R. atrocinerea

11* Ascospores *Physconia*-type. Thallus K- (atranorin absent).
R. sicula

12 Thallus K+ yellow (atranorin present).
13

12* Thallus K- (atranorin absent).
15

13 Ascospores *Mischoblastia*-type, 18-28 x 8-14 µm.
***R. oxydata* s. lat.** (incl. *R. vezdae*)

13* Ascospores *Physcia*-type.
14

14 Ascospores 11-16 x 5.5-8 µm. Apothecia up to 0.3 mm diam., usually becoming pseudolecanorine.
R. occulta

14* Ascospores larger, 14-22 x 7-11 µm. Apothecia larger, up to 1 mm diam., persistently lecanorine.
R. confragosa

15 Ascospores *Tunicata*-type, with a thick outer wall.
16

15* Ascospores different, without a thick outer wall.
18

16 Epihymenium blue-grey, K+, C+ and N+ violet. Ascospores 14-21 x 7-12 µm.
R. pityrea

16* Epihymenium brown, K-, C- and N-. Ascospores often larger.
17

17 Thallus indistinct (endolithic) to very thin and poorly developed. Apothecia becoming pseudolecanorine. Excipulum, hymenium and hypothecium interspersed with oil droplets.
R. tunicata

17* Thallus thick and well developed. Apothecia persistently lecanorine. Excipulum, hymenium and hypothecium not interspersed with oil droplets.
R. calcarea

18 Ascospores *Bischoffii*-type, with a heavily pigmented band around the septum.
19

18* Ascospores different, without a heavily pigmented band or with two heavily pigmented bands, one around each lumen.
20

19 Hymenium interspersed with abundant oil droplets. Apothecia not immersed in depressions of the substratum, sessile.
R. bischoffii

19* Hymenium not interspersed with oil droplets. Apothecia immersed in depressions of the substratum.
R. immersa

20 Ascospores *Bicincta*-type, with two heavily pigmented bands, one around each lumen, 13-19 x 7.5-10 µm.
R. lecanorina

20* Ascospores different, without two heavily pigmented bands.
21

21 Mature ascospores *Mischoblastia-* to *Pachysporaria*-type, 18-28 x 10-15 µm.
R. teichophila

21* Ascospores different, smaller.
22

22 Ascospore-ontogeny of type B. Ascospores *Dirinaria*-type, 11-16 x 6-9 µm.
R. gennarii

22* Ascospore-ontogeny of type A. Ascospores different.
23

23 Thallus indistinct (endolithic) to very thin and poorly developed, whitish. Prothallus absent. Apothecia ±immersed in depressions of the substratum. Mature ascospores *Physconia*-type. On calcareous rocks.
R. dubyana

23* Thallus distinct (always epilithic), olivaceous to dark brown, over a black prothallus. Apothecia never immersed in depressions of the substratum. Mature ascospores from *Physcia-* to *Physconia*-type. On siliceous rocks.
R. interpolata

THE SPECIES

1. *RINODINA ARCHAEA* (ACH.) ARNOLD

Flora **64**: 195 (1881).- Type: Locality not indicated (BM-ACH-lectotype!).

Further information: MAGNUSSON (1947), HUNECK & FOLLMANN (1970), DIEDERICH (1989), DIEDERICH & al. (1991), ROPIN & MAYRHOFER (1993) and GIRALT & MAYRHOFER (1995).

Thallus thin and smooth, whitish to pale red-brown. Apothecia lecanorine, scattered, adnate to sessile, 0.3-0.6 mm diam. Thalline margin thin, entire, usually persistent. Disc plane to subconvex, dark reddish brown. Hymenium 70-110 µm high. Epihymenium red brown. Asci *Lecanora*-type. Ascospores *Physconia*-type, 16-22 x 7-11 µm, torus well developed. Ascospore-ontogeny of type A.

Chemistry: No substances detected by TLC (Huneck & Follmann 1970; Giralt & Mayrhofer 1995). Zeorin was reported by Ropin & Mayrhofer (1993).

Discussion: *Rinodina archaea* is characterized by the poorly developed thallus lacking spot test reactions, the small apothecia and the large *Physconia*-type ascospores with a well developed torus. Among the other species considered, *R. archaea* could only be mistaken for *R. pyrina* which also has *Physconia*-type ascospores. However, the latter species is well separated by smaller ascospores which furthermore lack a well developed torus.

Ecology and distribution: There is only one collection of *R. archaea* from the studied area in Luxembourg (Werner 1962, as *R. pyrina*; Diederich 1989). Its label indicates that it was collected on *Fraxinus,* but there was no more detailed information about the habitat. Werner (1962) indicated that the specimen has been collected between Ettelbruck and Heiderscheid on *Fraxinus.* The associated species are *Parmelia glabratula* (= *Melanelia glabratula*) and *Physconia distorta.*

Additional specimen examined: LUXEMBOURG: Region Gutland: Ettelbruck, on *Fraxinus,* 25.3.1961, R. Werner-C230 (LUX).

2. *Rinodina aspersa* (Borrer) J.R. Laundon

Lichenologist **18**: 175 (1986).- Type: British Isles, England, Sussex, on flints, W. Borrer s.n. (BM-lectotype, not seen).

Further information: Huneck & Follmann (1970), Mayrhofer & Poelt (1979) and Mayrhofer (1984a), as *R. fatiscens*; Laundon (1986), Mayrhofer (1987), Fox & Purvis (1992), v.d. Boom & al. (1994a), Matzer & al. (1994) and Giralt & Barbero (1995).

Thallus composed of scattered areolae. Areolae rounded, flat and smooth, whitish to grey, up to 0.5 mm diam., mostly becoming sorediate. Soralia discrete, never forming a continuous leprose crust, concolorous or paler than areolae. Prothallus black. Apothecia not seen.
Chemistry: Areolae and soralia K+ yellow and C+ red; atranorin, gyrophoric acid (with lecanoric and orsellinic acids), umbilicaric, ovoic and 5-*0*-methylhiascic acids, by TLC (Giralt & Barbero 1995). Atranorin, gyrophoric and lecanoric acids were also reported by Follmann & Huneck (1970),

LEUCKERT & MAYRHOFER (1984), as *R. fatiscens*, LAUNDON (1986) and FOX & PURVIS (1992).

Discussion*:* *Rinodina aspersa* is characterized by its thallus composed of discrete soralia and its chemistry. It is the sorediate counterpart of *R. atrocinerea,* from which it differs in the production of soredia and the absence or scarcity of apothecia and spermogonia. Both species have identical chemistry. The sorediate thallus and the chemistry readily distinguish *R. aspersa* from the other species treated in the present paper. *Rinodina algarvensis* Giralt & al., a saxicolous, sorediate species recently described from Portugal (GIRALT & al. 1996) has a similar habit but is mainly distinguished by its alternative chemistry (stictic acid and several homologues in addition to atranorin and zeorin).

Ecology and distribution: The only collection of *R. aspersa* from the Netherlands dates from the last century and was previously mentioned by V.D. BOOM & al. (1994a). It was collected in the northern province of Drente, on a granitic megalithic monument. Associated species were *Candelariella* cf. *vitellina, Fuscidea cyathoides, Physcia tenella, Rhizocarpon distinctum* and *R. riparium.*
R. aspersa has also been reported from Belgium by DIEDERICH & al. (1988) but according to SÉRUSIAUX (pers. comm.) the specimens refer to *Fuscidea praeruptorum*. Two Belgian collections are mentioned here (see below). Both were growing along with *Xanthoparmelia conspersa.*
R. aspersa is here reported for the first time for Luxembourg. The specimens were collected in the northern part of the country, on exposed schistose rocks. At the collecting site, the accompanying species were *Buellia badia, Caloplaca subpallida, Candelariella vitellina, Diploschistes scruposus, Lecanora muralis, Leprocaulon microscopicum, Leproloma membranaceum, Neofuscelia loxodes, N. pulla, Physcia dubia, Rhizocarpon viridiatrum, Scoliciosporum umbrinum* and *Xanthoparmelia conspersa.*

Specimens examined: BELGIUM: Prov. Luxembourg: Bouillon, S of the castle, E exposed schistose rock, 250 m, 30.3.1991 (MB-25236). 4 km NW of La Roche, Jupille, bank of Ourthe, S slope, on exposed rock, 200 m, 4.3.1993 (MB-29406). **LUXEMBOURG**: Region Oesling: 3 km N of E of Esch-sur-Sûre, N of Heischtergronn, N shore of Sûre, S exposed sloping, on schistose rocks, 295 m, 25.5.1995 (PB-16817). 0.9 km SSW of Hoscheid, road to Goebelsmühle, 400 m, 25.5.1995 (PB-16805, 16811). **THE NETHERLANDS**: Prov. Drente: Borger, on granite, 250-550 m, 5.1849, R. v.d. Bosch (L).

3. *RINODINA ATROCINEREA* (HOOK.) KÖRB.

Systema lichenum Germaniae: 125 (1855).- Type: Herb. W. Whitering 59 (BM-lectotype, not seen).

(Fig. 3D)

Further information: SHEARD (1967), HUNECK & FOLLMANN (1970), MAYRHOFER & POELT (1979), HEKLAU & al. (1981), LAUNDON (1986), MAYRHOFER (1984a, 1987), DIEDERICH & al. (1988), FOX & PURVIS (1992), MATZER & al. (1994) and GIRALT & BARBERO (1995).

Thallus areolate. Areolae usually contiguous, smooth, flat to subconvex, whitish to pale grey. Apothecia lecanorine, scattered, up to 1 mm diam., adnate to sessile. Thalline margin thin, entire and usually persistent. Disc brown, plane to convex. Hymenium up to 120 µm high. Epihymenium brown. Asci *Lecanora*-type. Ascospores *Pachysporaria*-type, 14-20 x 9-12 µm, with lumina often showing protrusions towards spore-ends, torus developed. Ascospore-ontogeny of type A.

Chemistry: Thallus and thalline margin K+ and PD+ yellow and C+ red, epihymenium C+ red (microscopic slide!); atranorin, gyrophoric acid (with ±lecanoric and ±orsellinic acids), umbilicaric and 5'-*0*-methylhiascic acids, by TLC. In contrast to GIRALT & BARBERO (1995), ovoic acid was not detected in the specimen from the Benelux examined by TLC.Atranorin, gyrophoric and lecanoric acids were also reported by SHEARD (1967), FOLLMANN & HUNECK (1970), HECKLAU & al. (1981), LAUNDON (1986) and FOX & PURVIS (1992). FOX & PURVIS (op. cit.) have also found chloratranorin..

Discussion: *Rinodina atrocinerea* is characterized by its areolate, whitish thallus over a black prothallus, its *Pachysporaria*-type ascospores and its chemistry. Among the species treated, only *Rinodina aspersa*, its vegetative partner (POELT 1970, 1972), possesses the same features. However, the latter species differs from *R. atrocinerea* in the production of soredia, in the much reduced thallus development and in the absence or scarcity of apothecia (JAMES 1965; LAUNDON 1986; FOX & PURVIS 1992). The two species are chemically identical (see also comments under *R. aspersa*). *Rinodina sicula*, which also contains gyrophoric acid, is mainly distinguished by its *Physconia*-type ascospores.

The closely related *Rinodina alba* Metzler ex Arnold, a saxicolous species which also has *Pachysporaria*-type ascospores and the gyrophoric acid complex, is readily separated from *R. atrocinerea* by a I+ violet medullary reaction, significantly smaller ascospores, presence of 2''-*0*-methylgyrophoric acid and different distribution (compare GIRALT & BARBERO 1995 and ELIX & al. 1995).

Ecology and distribution: Up to now, *R. atrocinerea* is only known from Belgium in the Benelux (LAMBINON 1969; DIEDERICH & al. 1988). The very rich collection of Sérusiaux-7956 was associated with *Lasallia pustulata, Leproloma membranaceum* and *Trapelia involuta.*

Specimens examined: BELGIUM: Prov. Namur: Lustin, Sous la Haie, flanc droit du Ruisseau de Tailfer, 10.1985, E. Sérusiaux-7956 (LG).- Prov. Luxembourg: 5.5 km ESE of Bomal, Roche-à-Frêne, conglomerate rock on SW slope, 200 m, 6.4.1985 (MB-14368). 6 km SE of La Roche, Rocher du Hérou, rocks at shore of Ourthe, N of Hérou, 260 m, 4.4.1985 (MB-14450).

4. *RINODINA BISCHOFFII* (HEPP) A. MASSAL.

Fragmenti lichenographici: 26 (1855).- Type: Hepp: Flechten Europas 81 (L-isotype!).

(Figs. 2C, 6A)

Further information: SHEARD (1967), MAYRHOFER & POELT (1979), HECKLAU & al. (1981), MAYRHOFER (1983, 1984a-b, 1987), STEINER & MAYRHOFER (1987), BRAND & al. (1988) and FOX & PURVIS (1992).

Thallus from almost indistinct to ±developed, discontinuously granulose to continuous and cracked, grey. Apothecia lecanorine to rarely pseudolecanorine, sessile, up to 0.7 mm diam. Thalline margin entire, concolorous or darker than thallus, usually persistent. Disc plane to convex, dark brown to black, often with a pruinose appearance. Hymenium 80-100 µm high, interspersed with oil drops. Epihymenium dark brown. Asci *Lecanora*-type. Ascospores *Bischoffii*-type, 15-21 x 9-12 µm, torus absent. Ascospore-ontogeny of type A.
Chemistry: No substances detected by TLC.

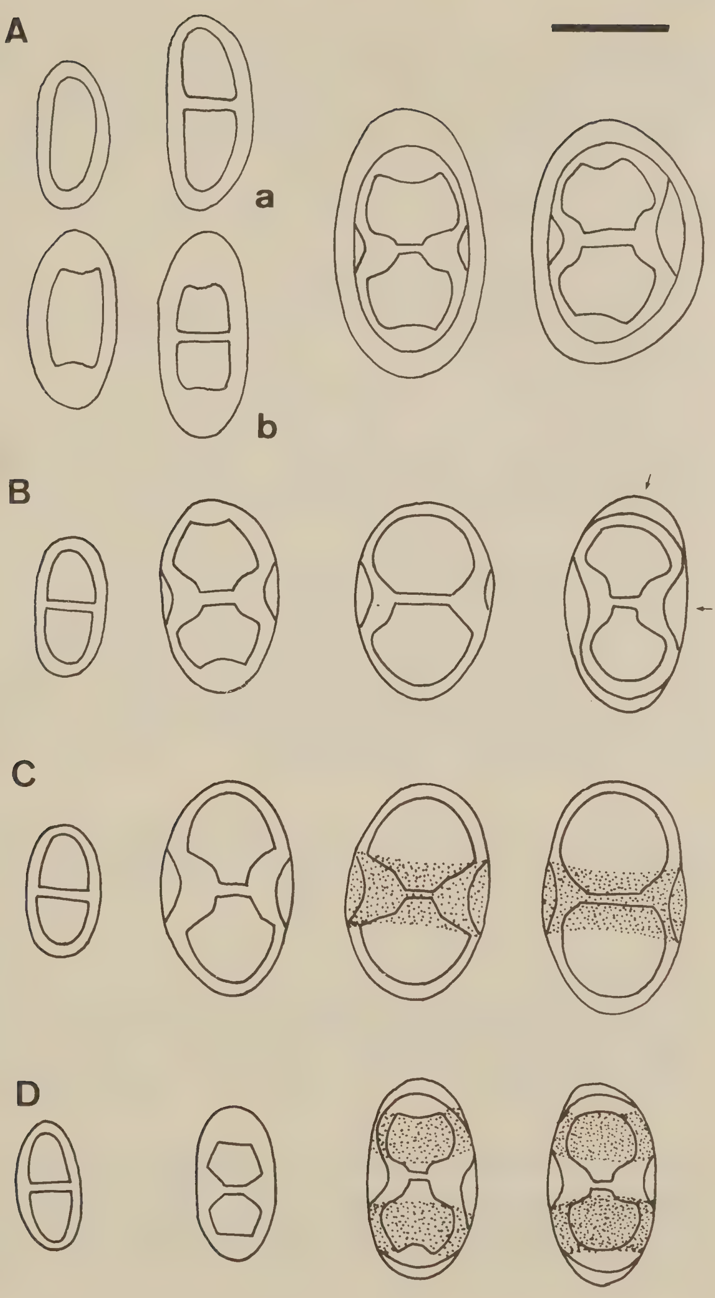
Discussion: As far as thallus development is concerned *Rinodina bischoffii* shows a wide range of variation, but as it is indicated in the epithet, the species is well characterized by its *Bischoffii*-type ascospores. Another typical feature can be found in the hymenium which contains plenty of oildrops. The only other species treated having the same ascospore-type is *R. immersa.* However, it is well distinguished by its pseudolecanorine apothecia which are deeply immersed in depressions of the substratum, and by the lack of oildroplets in the hymenium.

A species closely related to *Rinodina bischoffii* but not present in the studied area is *R. guzzinii* Jatta. It has a similar habit but a hymenium without oil droplets.

Ecology and distribution: *Rinodina bischoffii* has been collected on calcareous outcrops, mostly on exposed sites. Regarding the Benelux, *Rinodina bischoffii* seems to be most common in Belgium where it is usually found associated with *Aspicilia calcarea, A. contorta, Caloplaca aurantia, Clauzadea monticola, Lecanora muralis* and *Verrucaria nigrescens*. In the Netherlands it is widespread but it has been collected only in a few places. It was already known from Belgium (LAMBINON 1969) and the Netherlands (BRAND & al. 1988). *R. bischoffii* is here reported for the first time from Luxembourg.

Additional specimens examined: **BELGIUM**: Prov. Namur: Waulsort, affleurements calcaires, 25.6. 1896, Tonglet (LG). Dinant, Monia, rochers calcaires de la rive gauche dans un sous-bois, E. Sérusiaux-2075 (LG). Dailly, Gros Tienne du Bi, 6.1980, E. Sérusiaux-2121 (LG). E of Dinant, Fonds de Leffe, S slope in valley, on calcareous outcrop, 150 m, 28.4.1984 (MB-11325a, PB-1299). S of Philippeville, SE of Nismes, Fondry des Chiens, S exposed slope, on calcareous outcrop, 220 m, 2.4.1991 (PB-11024). SE of Philippeville, W of Treignes, on sloping calcareous outcrop, 4.4.1991 (PB-11065).- Prov. Liège: Terwagne, petits affleurements calcaires de la vallée du ruisseau de Bonne, au bord de la route de Seny, 30.3.1968, J. Lambinon-68/B/78 (LG).- Prov. Luxembourg: E of Bomal, N of Juzaine, open *Quercus* wood, on calcareous rock, 260 m, 31.3.1989 (PB-8210). **LUXEMBOURG**: Region Gutland: Dudelange, Gaalgebierg, 22.8.1981 (PD-3317). **THE NETHERLANDS**: Prov. Noord-Holland: Oudekerk aan de Amstel, Jewish Cementary, on limestone, 3.5.1995 (AA-35761).- Prov. Noord-Brabant: Den Bosch, N of Heusden, N exposed dike along harbour, on calcareous stone, 8.6.1992 (PB-12526).- Prov. Zuid-Limburg: E of Maastricht, Bemelerberg, on

Fig.2.- Aa-b: *Tunicata*-type ascospores of *R. calcarea* (LG) following an ascospore-ontogeny of both types, A **(a)** or B **(b)**. **B-D**: ascospore-ontogeny of type A: **B.** *Physconia*-type ascospores of *R. dubyana* (LG) (arrows: outer wall swelling around apices and septum). **C.** *Bischoffii*-type ascospores of *R. bischoffii* (MB-32119). **D.** *Bicincta*-type ascospores of *R. lecanorina* (MB-15142).


A
a
b
B
C
D

shaded calcareous rock, 5.7.1977, (AA-2045). Ibid. 1.5.1987, (AA-19331, PB-5357, 5383).- Prov. Zuid-Holland: Leiden, churchyard "Groenesteeg", on horizontal surface, 16.1.1994 (MB-30951).- Prov. Gelderland: 4 km W of Zaltbommel, Waalbandijk between Gameren and Nieuwaal, NE exposed dike, on calcareous stones, 7.4.1995 (MB-32119). 4 km E of Zaltbommel, 1 km SW of Hurwenen, Waalbandijk, NW exposed dike, on calcareous stones, 7.4.1995 (MB-32143).

5. *Rinodina calcarea* (Arnold) Arnold

Verh. zool.-bot. Ges. Wien **29**: 362 (1879).- Type: Arnold: Lich. exs. 161 (M-lectotype, GZU!, ZT-isotypes).

(Fig. 2Aa-b)

Further information: Mayrhofer & Poelt (1979), Hecklau & al. (1981), Mayrhofer (1984a), Brand & al. (1988) and Fox & Purvis (1992).

Thallus thick, discontinuous, rimose-areolate to areolate. Areolae smooth to granulose-verrucose, flat to convex, whitish grey to brownish, often with a pruinose appearance. Apothecia lecanorine, 0.5-0.8 mm diam., immersed to adnate/sessile. Thalline margin thick, persistent, concolorous with thallus. Disc plane, brown. Epihymenium reddish brown. Hymenium up to 120 µm tall. Asci *Lecanora*-type. Ascospores *Tunicata*-type, 20-26 x 11-15 µm, torus absent. Ascospore-ontogeny of both types, A or B.
Chemistry: No substances detected by TLC.

Discussion: *Rinodina calcarea* is well characterized by the thickly crustose to subsquamulose thallus which lacks lichens substances and the *Tunicata*-type ascospores. Two other species with *Tunicata*-type ascospores which occur in the studied area are *R. tunicata* and *R. pityrea.* The former is distinguished by its inconspicuous thallus, pseudolecanorine apothecia and interspersed excipulum, hymenium and hypothecium, while the latter is well separated by its blastidiate thallus, blue-grey and K+ violet epihymenium and significantly smaller ascospores. It is noteworthy that in one of the specimens examined (LG) at least parts of the thallus grow parasitically on *Rinodina lecanorina*.

Ecology and distribution: *Rinodina calcarea* seems to be a rather common species in the western part of central Belgium. Only one of the specimens examined is richly fertile (P. Malaise s.n., LG, see below). It was growing on an exposed calcareous rock in association with *Rinodina lecanorina,* *Caloplaca aurantia* and an unidentified *Caloplaca*. *Rinodina calcarea* was erroneously reported from Belgium by SÉRUSIAUX & al. (1983), with a specimen refering to *R. tunicata*. A sterile collection has also been reported from the Netherlands by BRAND & al. (1988). *R. calcarea* is not known from Luxembourg.

Additional specimens examined: BELGIUM: Prov. Luxembourg: Bomal, rive droite de l'Ourthe, en aval de la Ferme de Petite, rocher calcaire ensoleillé tombant dans la rivière, 120 m, 20.8.1982, P. Malaise (LG, richly fertile). 1.1 km E of Bomal, near the Belvédère, on S facing limestone rock, 180 m, 6.4.1985 (MB-14248, sterile).- Prov. Namur: 1.8 km NW of Profondeville, Roche Tailfer, E slope, on limestone, 100 m, 15.9.1986 (MB-15080, fertile). 4 km E of Couvin, Nismes, St. Joseph, S slope, on shaded limestone, 200 m, 16.9.1986 (MB-15092, fertile). 6 km NE of Couvin, Roche-à-Lomme, S slope, on shaded limestone, 210 m, 16.9.1986 (MB-15143, fertile). 1.8 km N of Dinant, Bouvignes, low limestone outcrops, 140 m, 8.8.1988 (MB-19366, sterile). 2 km NE of Dinant, Fonds de Leffe, S slope, on calcareous rock, 150 m, 28.4.1984 (MB-11311, fertile). 2 km E of Namur, Grands Malades, N shore of Meuse, on limestone, 100 m, 13.9.1989 (MB-21957, fertile). Valley of Meuse, 0.4 km NE of Waulsort, W slope, on N exposed limestone ridge, 180 m, 19.10.1991 (MB-26950, fertile).- Prov. Liège: Comblain-au-Pont, Roches Noires, on N facing calcareous rocks, 200 m, 13.5.1988 (MB-17861, sterile). **THE NETHERLANDS:** Prov. Zuid-Limburg: E of Maastricht, Bemelerberg, steep calcareous rock, 1.5.1987 (MB-16959, sterile).

6. *RINODINA CONFRAGOSA* (ACH.) KÖRB.

Systema lichenum Germaniae: 125 (1855).- Type: Ach. Coll. 387 (BM-holotype, not seen).

(Fig. 3A)

Further information: SHEARD (1967), MAYRHOFER & POELT (1979), HECKLAU & al. (1981), MAYRHOFER (1984a, 1987), MAYRHOFER & LEUCKERT (1985), FOX & PURVIS (1992), BAKKER (1994), GIRALT & BARBERO (1995) and MATZER & MAYRHOFER (1996).

Thallus usually thick, rimose to areolate, smooth to rugose, whitish, pale grey or pale green. Prothallus usually present. Apothecia lecanorine, sessile, abundant, up to 1.2 mm diam. Thalline margin thick, entire to crenulate, persistent. Disc dark brown to black, plane to convex. Hymenium 80-100 µm

tall. Epihymenium dark brown. Asci *Lecanora*-type. Ascospores *Physcia*-type, 14-22 x 7-11 µm, torus well developed. Ascospore-ontogeny of type A.
Chemistry: Thallus and thalline margin of apothecia K+ and PD+ yellow. The following compounds were detected by TLC in *R. confragosa:* atranorin (HUNECK & FOLLMANN 1970 and MAYRHOFER & LEUCKERT 1985); atranorin and zeorin (HECKLAU & al. 1981); & al. 1981); atranorin, ±chloratranorin and zeorin (HECKLAU & al. 1981, MAYRHOFER & LEUCKERT 1985 and GIRALT & BARBERO 1995).

Discussion: *Rinodina confragosa* is characterized by its usually well developed thallus, large lecanorine apothecia and large *Physcia*-type ascospores. Among the other species treated, *R. confragosa* could only be mistaken for *R. occulta* which also contains atranorin and has *Physcia*-type ascospores. However, the latter species is well separated by smaller apothecia which usually become pseudolecanorine and smaller ascospores (see also comments under *R. occulta*).
Rinodina beccariana, similar in habit and chemistry, is distinguished from *R. confragosa* by its *Pachysporaria*-type ascospores and significantly different ecology and distribution (compare MAYRHOFER & al. 1993).

Ecology and distribution: This species seems to be rare in the Benelux. It was found only once in a shaded and sheltered locality in the Netherlands, on a granite boulder of a megalithic monument in association with a very rich lichen community including thirty-six species (BAKKER 1994). Hitherto, it is not known from Belgium and Luxembourg.

Specimen examined: **THE NETHERLANDS**: Prov. Drente: Rolde, megalithic monument D 17, on granite, 18.10.1993, S. Bakker (PB-15240).

7. *RINODINA CONRADII* KÖRB.

Systema lichenum Germaniae: 123 (1855).- Type: Locality not indicated, herbarium Koerber (L-holotype, not seen).

(Fig. 1A)

Further information: ABELEVEN (1898), SHEARD (1967), MAYRHOFER (1984b), BRAND & al. (1988), FOX & PURVIS (1992), GIRALT (1994) and KRENN (1994).

Thallus thin, continuous, smooth to rugose, pale grey to brownish. Apothecia lecanorine, sessile, abundant and confluent, 0.3-0.7 mm diam. Thalline margin concolorous with thallus, persistent. Disc plane to convex, brown.

Hymenium up to 120 µm tall. Epihymenium reddish brown. Asci *Lecanora*-type. Ascospores *Conradii*-type, 25-31 x 10-15 µm, smooth, torus not or, rarely, poorly developed. Ascospore-ontogeny of type B.
Chemistry: No substances detected by TLC.

Discussion: *Rinodina conradii* is characterized by its thin thallus, its abundant and convex apothecia and its *Conradii*-type ascospores which originate via a type B ontogeny. *R. conradii* cannot be confused with any other species treated in the present paper because it is unique in having mature ascospores with four lumina (*Conradii*-type).

Ecology and distribution: *Rinodina conradii* is a terricolous species which can also grow on wood, mosses, decaying plant debris or similar substrates. It was already reported from the studied area last century by ABELEVEN (1898, specimen not seen). The specimen MB-27027, previously mentioned by BRAND & al. (1988), was curiously collected on rabbit drops. *R. conradii* is not known from Belgium and Luxembourg.

Specimens examined: THE NETHERLANDS: Prov. Noord-Holland: Groote Vlak, open dune area, on wood, 5.5.1982 (AA-11810). Zandvoort, Musschenveld, open dunes area, on rabbit drops, 23.3.1992 (MB-27027).

8. *RINODINA DUBYANA* (HEPP) J. STEINER

Verh. zool.-bot. Ges. Wien **69:** 60 (1919).- Type: Hepp: Flechten Europas 322 (M-holotype!).

(Fig. 2B)

Further information: MAYRHOFER & POELT (1979) and MAYRHOFER (1984a, 1987).

Thallus indistinct (endolithic or epilithic but inconspicuous), whitish to grey. Apothecia from the beginning pseudolecanorine, first immersed in depressions of the substratum, then ±adnate, brown to black, 0.3-0.5 mm diam. Disc plane to subconvex. Proper margin concolorous with disc, thick and usually persistent. Hymenium 80-100 µm tall. Epihymenium dark brown. Asci *Lecanora*-type. Ascospores *Physconia*-type, 14-18 x 8-10 µm, torus absent. Ascospore-ontogeny of type A.
Chemistry: No substances detected by TLC.

Discussion: *Rinodina dubyana* is characterized by its indistinct to inconspicuous, whitish thallus, its pseudolecanorine apothecia ±immersed in depressions of the substratum, and its *Physconia*-type ascospores. *R. immersa* and *R. tunicata* with similar habit differ mainly by possessing *Bischoffii*- and *Tunicata*-type ascospores, respectively.

Dubyana-type ascospores (MAYRHOFER 1982) seem to differ from that of the typical *Physconia*-type only in the somewhat thicker spore wall, especially at the apices and in the septum region of the spores (compare figs. 2B and 3C). This feature can be better observed in KOH. Such a minute difference is, in our opinion, too vague to distinguish between the two ascospore-types. Therefore, as SCHEIDEGGER (1993), we prefer to include the *Dubyana*-type in the *Physconia*-type.

The ascospores of *R. dubyana* show some variation as far as apical internal wall-thickenings are concerned: some show more or less pronounced apical wall-thickenings (*Physcia*- or *Milvina*-thickenings, respectively) while others are of typical *Physconia*-type (the lumina at their distal ends are rounded).

Ecology and distribution: In the studied area, *Rinodina dubyana* is only known from the southern part of Belgium. The specimens examined were collected on calcareous rocks in association with *Aspicilia contorta, Bagliettoa* sp., *Caloplaca flavescens, Protoblastenia incrustans, P. rupestris* and *Verrucaria* cf. *caerulea*. It was previously reported from the same area by MAYRHOFER (1984a). Hitherto, it is not known from Luxembourg and the Netherlands.

Additional specimens examined: BELGIUM: Prov. Namur: Nismes, Plateau des Abannets, paroi calcaire du Fondry des Chiens, 30.7.1962, J. Lambinon-62/B/955 (LG). SSE of Dinant, 1.2 km of Furfooz, Parc National, S exposed slope, on calcareous outcrop, 16.4.1993 (PB-13954).

9. *RINODINA EFFLORESCENS* MALME

Svensk Bot. Tidskr. **21**: 251 (1927).- Type: Sweden, Västergötland, Habo, St. Kärr, on old *Fagus* in a shady place, 1923, G.O. Malme (S, not seen).

(Fig. 6B)

Further information: MAGNUSSON (1947), COPPINS & JAMES (1979), SÉRUSIAUX & ROSE (1984), WITTMANN & TÜRK (1987), BRAND & al. (1988), DIEDERICH (1989), WIRTH (1990, as *R. hueiana*), ETAYO (1992), Tønsberg (1992), FOX & PURVIS (1992), GIRALT & al. (1993, 1994, 1995).

Thallus composed of scattered to contiguous areolae. Areolae pale brownish, 0.1-0.5 mm diam. Soralia scattered to sometimes ±confluent but never forming a continuous leprose crust, greenish or yellowish, 0.2-0.4 mm diam. Apothecia not seen.
Chemistry: Thallus PD+ orange; pannarin (and several unidentified satellites), zeorin and efflorescens unknown pigment by TLC.

Discussion: *Rinodina efflorescens* is characterized by its brownish and scattered areolae dissolving into greenish or yellowish, discrete soralia, which never form a continuous leprose crust, and its pannarin content. *Rinodina griseosoralifera* has a thallus and soralia similar in appearance but areolae and soralia are whitish to bluish and give a K+ faint yellow (atranorin) rather than a PD+ orange reaction. When fertile, the two species are separated by their different ascospore-type, which is of *Pachysporaria*-type in *R. griseosoralifera* and of *Physcia*-type in *R. efflorescens* (compare COPPINS 1989; GIRALT & al. 1993, 1994, 1995).

Ecology and distribution: *R. efflorescens* is one of the most frequent corticolous *Rinodina* species of the genus in the Benelux. In the Netherlands, it is known only from the northwest, in the coastal dune area near Bergen and Castricum. In southern and eastern Belgium and, especially, in Luxembourg it is widespread and rather common. It is found mostly on *Quercus*, sometimes overgrowing thalli of *Hypogymnia physodes, Parmelia glabratula* (= *Melanelia glabrarula*) or *P. saxatilis.* Other often accompanying species are *Evernia prunastri, Lecidella elaeochroma, Lepraria* spp. and hepatics (*Frullania* sp). From the studied area, it was previously reported by SERUSIAUX & ROSE (1984) and DIEDERICH (1989).

Selected specimens examined: **BELGIUM**: Prov. Hainaut: Virelles, futaie de la rive N du lac, dominée par *Quercus,* sur *Quercus,* 10.1984, E. Sérusiaux-6919 (LG).- Prov. Namur: Olloy/s/Viroin, vallée du Ruisseau de Noye, sur *Quercus,* 12.1984, E. Sérusiaux-7062 (LG).- Prov. Luxembourg: Suxy, futaie sur le flanc Nord du Vague des Gomhets, 6.1983, E. Sérusiaux-4906b & F. Rose (LG). Habay-la-Neuve, vallée du Ruisseau d'Arlune, en aval de la confluence avec le Tordu Ruisseau, sur *Acer,* 10.1983, E. Sérusiaux-6128 (LG). Buzenol, vallée du Gros Ruisseau, à hauteur du cron de Montauban, frênaie alluviale, sur *Fraxinus,* 6.1984, E. Sérusiaux-6367b (LG). **LUXEMBOURG**: Region Oesling: SE of Martelange, S of Perlé, on *Quercus,* 18.4.1985 (PD-5944). Lellgerbaach, on *Quercus,* 11.10.1986 (PD-7708, 7709). Heiderscheid, on *Quercus,* 13.11.1983 (PD-5003). E of Fouhren, Hinkelsbaach, on *Fraxinus,* 18.8.1986 (PD-7255). WSW of

Boulaide, on *Quercus,* 23.8.1987, P. Diederich-8498, (E). SSE of Brachtenbach, on *Quercus,* 8.9.1987 (PD-8696). W of Tadler, Riitgen, on *Quercus,* 9.9.1987 (PD-8669). SSW of Hoscheid, road to Goebelsmühle, steep S slope, on *Tilia,* 30.3.1989 (MB-20148).- Region Gutland: Blaschette, Bëddelboesch, on *Quercus,* 17.12.1983 (PD-5044). Berdorf, Zickzackschloeff, on *Quercus,* 19.6.1984 (PD-5505). NWW of Greiveldange, Néisboesch, on *Quercus,* 31.8.87 (PD-8599). Grünewald, 'Kaleflesschen', 5.6.1963, H. van Wersch (LUX). **THE NETHERLANDS**: Prov. Noord-Holland: Castricum, dune area near Kijk-uit, 11.6.1986 (AA-16025). Bergen, Noord-Duinreservaart, on *Quercus,* 13.9.1986 (AA-16983). Ibid., dune area near Zeeweg, on *Quercus,* 15.9.1991 (AA-28189; PB-12090). Ibid., on *Quercus,* 11.1990 (AA-27156). SW of Castricum, *Quercus* wood in dunes, on *Quercus,* 14.9.1991 (PB-12082, 12084).

10. *RINODINA GENNARII* BAGL.

Comment. Soc. Critt. Ital. **1**: 17 (1861).- Type: Italy, Liguria occidentale. "alle falde del monte Faiallo nell'Apennino di Voltri", F. Baglietto (WU-isotype, not seen).

(Fig. 1Ba-b)

Further information: SHEARD (1967) and LAMBINON (1969), as *R. subexigua*; MAYRHOFER & POELT (1979), HECKLAU & al. (1981), MAYRHOFER (1983, 1984a-b, 1987), STEINER & MAYRHOFER (1987), BRAND & al. (1988, as *R. exigua*), FOX & PURVIS (1992), V.D. BOOM & al. (1994b) and MATZER & MAYRHOFER (1996).

Thallus thin, continuous or not, smooth to ±granulose, whitish grey to greenish grey to greyish brown. Apothecia lecanorine, rarely becoming pseudolecanorine, abundant and crowded, sessile, up to 0.5 mm diam. Thalline margin thin, entire, usually persistent, concolorous or darker than the thallus. Disc plane to convex, dark brown to black. Hymenium 60-80 µm high. Epihymenium dark brown. Asci *Lecanora*-type. Ascospores *Dirinaria*-type, 11-16 x 6-9 µm, swelling around the septum with KOH, torus absent or, rarely, poorly developed. Ascospore-ontogeny of type B.
Chemistry: No substances detected by TLC.

Discussion: The small, abundant and contiguous apothecia, the small *Dirinaria*-type ascospores and the lack of secondary lichen compounds are diagnostic of *R. gennarii.*

According to our observations, only the habitat separates this species from the corticolous/lignicolous *R. oleae* (compare GIRALT & MAYRHOFER 1995), but before establishing the synonymy or treating both taxa as varieties or subspecies, their distribution and habitat preferences should be studied more in detail.

It should be noted that in one of the specimens examined the majority of mature ascospores possess *Physconia*-wall thickenings. As no other separating characters could be found, it is included in *R. gennarii*. This variability was also observed in two specimens of *R. oleae*: another argument which may indicate both taxa to be conspecific.

Ecology and distribution: *Rinodina gennarii* is widely distributed in the Benelux, where it occurs on a wide range of substrata, such as mortar, red brick, sandstone, basalt and granite. The species is somewhat nitrophilous and grows together with *Candelariella vitellina, Phaeophyscia orbicularis, Physcia adscendens, P. caesia* and *P. tenella.* On coastal rocks it was found in the sublittoral zone associated with *Caloplaca saxicola, Candelariella medians, Lecanora dispersa* and *Xanthoria parietina. R. gennarii* is most common in anthropogenic communities on brick walls where it usually grows together with *Caloplaca citrina, Lecania erysibe, L. rabenhorstii*, *Lecanora albescens* and *L. dispersa.* It occurs in heavily polluted areas of Benelux. *R. gennarii* has been reported several times from the studied area (LAMBINON 1969, as *R. subexigua,* MAYRHOFER 1984a, BRAND & al. 1988, as *R. exigua,* and V.D. BOOM & al. 1994b).

Selected specimens examined: **BELGIUM**: Prov. West-Vlaanderen: Nieuwpoort, sur la digue en briques du chenal, à hauteur de la crique, 14.6.1960, J. Lambinon-60/B/1098b (LG). Middelkerke, dans les dunes, sur un bunker, 17.6.1967, J. Lambinon-67/B/389 (LG). W of Veurne, Adinkerke, dunes du Westhoek, sur bunker, 18.6.1967, J. Lambinon-67/B/427 (LG). Nieuwpoort, Ijzersluis, on S exposed calcareous rock of dike, 22.5.1988 (MB-17937).- Prov. Limburg: ENE of Visé, 's-Gravenvoeren, on mortar, 6.7.1979 (AA-6381).- Prov. Hainaut: W of Mons, Harchies, terril plat entre le canal et les marais, 4.5.1968, J.Duvigneaud-68/B/639 (LG).- Prov. Namur: NW of Dinant, Graux, vieux mur calcaire dans le village, 16.4.1968, J. Lambinon-68/B/102 (LG). SW of Dinant, E of Hastière, Domaine du Bonsoy, wall along garden, on mortar, 7.4.1983 (PB-354). S of Namur, Rochers de Néviau, top of W-facing rock, 120 m, 13.9.1989 (MB-21964). SSE of Philippeville, Le Mesnil, churchyard, on brick and mortar, 320 m, 3.4.1991 (PB-11083). **LUXEMBOURG**: Region Oesling: N of Clervaux, Binsfeld, wall along church, 465 m, 9.5.1991 (PB-11211). N of Clervaux, Wilwerdange, wall of church, on mortar, 510 m, 2.5.1992 (PB-12469).- Region Gutland, W of Echternach, Beaufort, on N facing rock of castle, 350 m, 7.4.1988 (PB-6711). **THE NETHERLANDS**: Prov. Friesland: Wadensea island Vlieland, Kroonpolders, lock on brick, 31.3.1948, R. Maas Geesteranus-4002b, 4003 (L). Waddensea island Ameland, near pier of Nes, 2.5.1971 (HS-3740). Hindeloopen, wall of church, on brick, 23.9.1989 (AA-26646). Hindeloopen, shore of former sea, on granite, 23.9.1989 (AA-26680). Paesens, dam in Waddensea, on basalt, 26.6.1992 (MB-27427).- Prov. Groningen: Waddensea island Rottumerplaat, on wall, 28.5.1977, P.v.d.Knaap (AA). Sellingen, on wall of church, 30.4.1978 (AA-6877, 6878).- Prov. Drente: Emmen, megalithic monument D 43, on granite, 26.3.1994 (AA-33916, PB-15318, 15319).- Prov. Noord-Holland: Amsterdam, near Zaagmolenpoort, wall, on red brick, 12.1848, C. v.d. Sande Lacoste (L). Bennebroek, brick wall, on brick. 28.6.1942, R. Maas Geesteranus-1976 (L). Bergen, De Voert, old lock, 12.5.1954, R. Maas Geesteranus-9690 (L). Castricum, dunes, 29.9.1977 (AA-2189). Wieringen, dike of former Zuiderzee, 9.9.1979 (AA-3390). Waddensea island Texel, Oudeschild, harbour, coastal rock, littoral, 18.9.1988 (AA-23836). Ibid., on shells (AA-23836). Heemskerk, dune area near Berenweide, on path, on brick, 20.6.1990 (AA-26810). Naarden-Vesting, 30.4.1994 (AA-34104, PB-15412).- Prov. Overijssel: SW of Vollenhove, along Kadoeler lake, W exposed dike, 28.04.1991 (PB-11165). Zalk, church, on mortar (AA-27845).- Prov. Flevoland: Schokland, former harbour, on basalt, 28.4.1991 (AA-27902). Ibid., on limestone, (AA-27893).- Prov. Zuid-Holland: Goeree, Stellendam, church, N side, on sloping stone, 7.1991 (MB-26239). NE of Leiden, Hoogmade, Noord-Aa, on basalt, 5.1921, C. Cool (L). Goeree, Stellendam, church, N side, on sloping stone, 7.1991 (MB-26239). W of Leiden, Katwijk aan Zee, shore, on basalt, 1.6.1941, R. Maas Geesteranus-815b (L). E of Leiden, Koudekerk a.d. Rijn, Lage Waard, bridge, on brick, 19.4.1943, R. Maas Geesteranus-2433b (L).- Prov. Zeeland: Zuid-Beveland, Goes, on wood, 1851, R. v.d. Bosch (L). Noord-Beveland, Wissekerke, Geersdijk, S exposed dike, on basalt, 5.7.1958, Maas Geesteranus-12549 (L). Wemeldinge, dike of Oosterschelde, supralittoral, 5.2.1981 (HS). Schouwen, SSE of Haamstede, harbour, supralittoral, on basalt, 7.5.1988 (PB-6825).- Prov. Noord-Brabant: N of Den Bosch, road to Hedel, on pebbles, 8.4.1905, J. Wakker (L). N of Eindhoven, Son, 26.2.1983 (PB-264). N of Eindhoven, St. Oedenrode, Moerkuilen, 12.3.1983 (PB-268). N of Eindhoven, Breugel, church (14th century), 22.11.1983 (PB-653). Boxtel, church, brick wall, on mortar, 26.6.1987 (PB-5628). Westerhoven, Weerderdijk, bridge, on brick, 29.12.1987 (PB-5878). Bergeyk, Eykereind, 13.2.1988 (PB-6300). Oostelbeers, church, brick wall, on red brick, 16.8.1989 (PB-9100).- Prov. Zuid-Limburg: Heel, churchyard, brick wall, 5.5.1980. NNW of

Venlo, Well, wall along old churchyard, on red brick, 15.8.1992 (PB-13557). NNW of Geldrop, road to Urkhoven, bridge, on mortar, 3.4.1993 (PB-13806).

11. *RINODINA GRISEOSORALIFERA* COPPINS

Lichenologist **21**: 169 (1989).- Type: British Isles, Scotland, Caledonia, Berwickshire, Duns Park, 150 m, on *Fagus sylvatica*, 10.11.1981, Fox (E-holotype!).

Further information: COPPINS (1989), TÜRK & al. (1987), DIEDERICH (1989), DIEDERICH & al. (1991), Tønsberg (1992), SCHREINER & HAFELLNER (1992), FOX & PURVIS (1992), V.D. BOOM & al. (1994b) and GIRALT & al. (1993, 1995).

Thallus composed of scattered to contiguous areolae. Areolae whitish to pale grey, up to 0.2 mm diam. Soralia scattered to ±confluent but never forming a continuous leprose crust, 0.2-0.4 mm diam., whitish to pale blue grey. Apothecia not seen.
Chemistry: areolae and soralia K+ yellow, PD+ faintly yellow; atranorin and zeorin, by TLC.

Discussion: *Rinodina griseosoralifera* is characterized by its small, discrete and whitish areolae dissolving into whitish to blue-grey soralia and its chemistry (atranorin and zeorin). The sorediate *R. efflorescens* is mainly separated by its content of pannarin (see comments under this species).
A species closely related to *R. griseosoralifera* is *R. inflata* (KALB 1976). It is mainly distinguished by its larger and subsquamulose areolae (compare GIRALT & al. 1993, 1995).
The sorediate *Buellia griseovirens,* which has also a similar habit, can be separated from *R. griseosoralifera* by its more continuous thallus which reacts PD+ yellow-orange and K+ red due to the presence of norstictic acid and other substances of the stictic acid complex (compare COPPINS 1989, FOX & PURVIS 1992 and TØNSBERG 1992).

Ecology and distribution: *Rinodina griseosoralifera* was known only from a small collection (LUX) from Luxembourg within the Benelux (DIEDERICH 1989). This sample lacks associated species. Recently, two additional collections, also from Luxembourg, were found growing along with *Lepraria* spp., *Micarea prasina* and *Parmelia sulcata.* They were already reported by DIEDERICH & al. (1991) and V.D. BOOM & al. (1994b). The species is reported here for the first time for the Netherlands. It was growing on *Salix* together with *Bacidina arnoldiana* and *B. delicata*. The species is not known from Belgium.

Additional specimens examined: **LUXEMBOURG**: Region Oesling: N of Bigonville, Moulin de Bigonville, near hotel, on mossy trunk of *Quercus,* 340 m, 2.5.1992 (PB-12286).- Region Gutland: SW of Septfontaines, W of Sauerwisen, on *Pyrus,* 14.9.1979 (PD-1955). S. loc., c. 1840, Tinant-103 (LUX). **THE NETHERLANDS:** Prov. Noord-Brabant: Eindhoven, NW of Geldrop, Collse Zeggen, very damp wood, on *Salix*, 3.5.1995 (PB-16795).

12. *RINODINA IMMERSA* (KÖRB.) ARNOLD

Flora **67:** 319 (1884).- Type: Germany, Bayern, Arnold (L-holotype!).

Further information: MAYRHOFER & POELT (1979), MAYRHOFER (1983, 1984a, 1987) and FOX & PURVIS (1992).

Thallus indistinct (endolithic or epilithic but inconspicuous), whitish to grey. Apothecia from the beginning pseudolecanorine, immersed in deep depressions of the substratum, rarely becoming ±adnate, dark brown to black, 0.3-0.6 mm diam. Disc plane to subconvex. Proper margin concolorous or paler than disc, thin, usually persistent. Hymenium 80-100 µm tall. Epihymenium dark brown. Asci *Lecanora*-type. Ascospores *Bischoffii*-type, 16-21 x 10-12 µm, torus absent. Ascospore-ontogeny of type A.

Chemistry: No substances detected by TLC (FOX & PURVIS 1992).

Discussion: The pseudolecanorine apothecia, immersed in deep depressions of the substratum, and the *Bischoffii*-type ascospores are diagnostic of *R. immersa.* Among the species treated only *R. bischoffii* possesses the same ascospore-type. However, the latter species is well separated by its better developed thallus, lecanorine and prominent apothecia and its hymenium interspersed with oil droplets. *R. dubyana* differs from *R. immersa* mainly in the ascospores which lack the pigmented band around the septum (*Physconia*-type).

Ecology and distribution: *Rinodina immersa* is probably an overlooked species which grows on calcareous rocks. Hitherto, only two collections from southern Belgium are known in the Benelux. One of them (16.7.1890, Conglet (PC)), was reported by MAYRHOFER (1984a). The other collection, the only one examined, was growing on a south exposed calcareous slope together with other calcicolous lichens such as *Agonimia tristicula, Anema* sp., *Caloplaca ochracea, C. variabilis, Catapyrenium pilosellum, Clauzadea immersa, C. monticola, Collema* spp., *Lecanora crenulata, L. pruinosa,* *Leptogium schraderi, Lobothallia radiosa, Petractis clausa, Rinodina bischoffii, Synalissa symphorea, Thelidium* spp., *Thyrea pulvinata, Toninia tumidula* and *Verrucaria* spp. *R. immersa* is not known from Luxembourg and the Netherlands.

Additional specimen examined: **BELGIUM**: Prov. Namur, 2km NE of Dinant, Fonds de Leffe, S slope in valley, on calcareous outcrops, 150 m, 28.4.1984 (MB-11325).

13. *RINODINA INTERPOLATA* (STIRT.) SHEARD

Lichenologist **5**: 461 (1973).- Type: Scotland, near Garvie, Ross-shire, 8.1887, Stirton (BM-holotype!).

(Fig. 3B)

Further information: SHEARD (1967, as *R. occulta*), SHEARD 1973), MAYRHOFER & POELT (1979), MAYRHOFER (1984a), LEUKERT & MAYRHOFER (1984), DIEDERICH & al. (1992) and FOX & PURVIS (1992).

Thallus thin, areolate to rimose areolate. Areolae discrete to contiguous, smooth, olivaceous to brown. Prothallus black. Apothecia at first lecanorine, usually becoming pseudolecanorine, sessile, up to 0.4 mm diam. Thalline margin concolorous with thallus, persistent or not. Disc plane to subconvex, dark brown to black. Hymenium up to 80 µm tall. Epihymenium reddish brown. Asci *Lecanora*-type. Ascospores *Physcia*-type, often grading into the *Milvina*- or *Physconia*-type, 14-19 x 7.5-9 µm, torus not or poorly developed. Ascospore-ontogeny of type A.
Chemistry: No substances detected by TLC. Zeorin was detected by LEUCKERT & MAYRHOFER (1984).

Discussion: *Rinodina interpolata* is characterized by its rimose-areolate to areolate, brownish thallus, lacking spot test reactions, its black prothallus, its small apothecia usually becoming pseudolecanorine and its *Physcia*-type ascospores grading into the *Milvina*- or *Physconia*-type when mature. Among the species treated it can be confused with *R. occulta*, a species with similar habit and ascospore-type but possessing atranorin (K+ yellow).
In contrast to LEUCKERT & MAYRHOFER (1984), in none of the specimens examined from the studied area (see below) as well as from other regions (BM, LISU-3114) the presence of zeorin could be detected by TLC.
Rinodina interpolata could also be mistaken for *R. sicula*. The paler thallus containing gyrophoric and lecanoric acid together with the persistently

lecanorine apothecia and the typical *Physconia*-type ascospores separate *R. sicula*.

Ecology and distribution: Although several collections from adjacents regions (France) are known (DIEDERICH & al. 1988), *Rinodina interpolata* has only once been found in the Benelux (DIEDERICH & al. 1992) where it was growing on schistose rocks without associated species. The record in V.D. BOOM & al. (1994b) refers to *R. sicula*. It is not known from Luxembourg and the Netherlands.

Additional specimen examined: **BELGIUM:** Prov. Luxembourg: 1 km S of Vielsalm, Cahay, abandoned schist quarry, on shaded overhang, 18.4.1990 (PB-9457).

14. *RINODINA LECANORINA* (A. MASSAL.) A. MASSAL.

Geneacaena lichenum: 19 (1854).- Type: Italy, Lombardia, Verona, Loveno, S. Garovaglio (VER-lectotype, not seen).

(Fig. 2D)

Further information: LAMBINON (1969), HUNECK & FOLLMANN (1970), HECKLAU & al. (1981) and MAYRHOFER & POELT (1979), as *R. ocellata*; MAYRHOFER (1983, 1984a, 1987) and MAYRHOFER & al. (1990).

Thallus thick, areolate. Areolae flat to subconvex, smooth, pale to dark grey or greyish-brown. Prothallus absent but areolae brown at the base and often also at the margins. Apothecia cryptolecanorine to lecanorine, 0.5-0.8 mm diam. Thalline margin concolorous with thallus, persistent. Disc plane to subconvex, dark brown to black. Hymenium up to 90 µm tall. Epihymenium reddish brown. Asci *Lecanora*-type. Ascospores *Bicincta*-type, 13-19 x 7.5-10 µm, torus absent. Ascospore-ontogeny of type A.

Chemistry: Zeorin by TLC. This substance was also reported by HECKLAU & al. (1981) and HUNECK & SCHMIDT (1995). HUNECK & FOLLMANN (1970) detected two unidentified substances.

Discussion: *Rinodina lecanorina* is characterized by its well developed thallus composed of contiguous and large areolae which do not give spot test reactions, its cryptolecanorine to lecanorine apothecia and its ascospores with a heavily pigmented band around each lumen. It cannot be mistaken for any of the other species considered because it is unique in having *Bicincta*-type ascospores. The closely related *R. luridata* is mainly distinguished by its less developed thallus and significantly smaller apothecia and ascospores (compare MAYRHOFER & al. 1990).

Ecology and distribution: *Rinodina lecanorina* is not rare in central Belgium where it occurs on exposed calcareous rocks. It forms usually extensive patches among other calcicolous lichens such as *Aspicilia calcarea, A. contorta, Caloplaca aurantia, C. flavescens, Lecanora* cf. *albescens*, *Placynthium nigrum* and *Solenopsora candicans.* The species was already mentioned from Belgium by LAMBINON (1969), MAYRHOFER (1984a) and MAYRHOFER & al. (1990). It is not known from Luxembourg and the Netherlands.

Specimens examined: **BELGIUM**: Prov. Namur: WNW of Dinant, Sosoye, Rochers de Sosoye, on S exposed calcareous rock, 30.7.1962, J. Lambinon-62/B/917 (LG). Han-sur-Lesse, Roche à Serin, crête de rochers calcaires ensoleillés, 11.6.1967, J. Lambinon-67/B/308 (LG). S of Philippeville, W of Couvin, Dailly, on calcareous rocks, 23.6.1968, J. Lambinon-68/B/543 (LG). Dinant, Monia, rochers de la rive gauche, 5.1980, E.Sérusiaux-2093 (LG). Dailly, Gros Tienne du Bi, 6.1980, E. Sérusiaux-2123 (LG). NE of Couvin, NE of Nismes, Roche-à-Lomme, 16.9.1986 (MB-15142). N of Dinant, Bouvignes, flat limestone grassland on top of the hill, on stones, 140 m, 8.8.1988 (MB-19384). S of Rochefort, path from Hamerenne to Han-sur-Lesse, on exposed calcareous rock, 250 m, 27.3.1989 (PB-8232). S of Philippeville, SE of Nismes, Fondry des Chiens, S exposed slope, on calcareous outcrop, 2.4.1991 (PB-11027).- Prov. Luxembourg: NE of Durbuy, Rochers de Glawans, SW exposed slope, on calcareous rock, 270 m, 29.3.1989 (PB-8186). E of Marche-en-Famenne, S exposed slope, on calcareous rock, 250 m, 29.4.1990 (PB-9522).

15. *RINODINA OCCULTA* (KÖRB.) SHEARD

Lichenologist **3**: 349 (1967).- Type: “Ad rupes umbrosas faucis Wolfsschlucht in monte Kynast Sudetorum”, Koerber (M-isotype!, as Koerber: Lich. sel. germ 34).

Further information: SHEARD (1967, 1973), HECKLAU & al. (1981), MAYRHOFER & POELT (1979), MAYRHOFER (1984a-b, 1987), MAYRHOFER & LEUCKERT (1985, as *R. attica*), FOX & PURVIS (1992) and GIRALT & BARBERO (1995).

Thallus thin, rimose areolate to areolate. Areolae discrete to contiguous, small, thin, smooth, whitish to pale grey. Prothallus black. Apothecia first lecanorine and ±innate, usually becoming pseusolecanorine and adnate, dark brown to black, up to 0.3 mm diam. Disc plane to convex. Proper exciple concolorous with disc, thin, persistent or not. Hymenium 60-80 µm high. Epihymenium dark brown. Asci *Lecanora*-type. Ascospores *Physcia*-type, 11-16 x 5.5-8 µm, some of them showing tendencies towards the *Physconia*-type when mature, torus not or poorly developed. Ascospore-ontogeny of type A.

Chemistry: Thallus and thalline margin of apothecia (when present) K+ and PD+ yellow; atranorin and ±chloratranorin, by TLC.

Discussion: *Rinodina occulta* is characterized by its thin thallus, reacting K+ yellow (atranorin), its small pseudolecanorine apothecia and its small *Physcia*-type ascospores. *R. occulta* could be mistaken for *R. confragosa,* a species which also possesses atranorin and *Physcia*-type ascospores. However, the latter is well separated by its better developed and thicker thallus, larger and persistently lecanorine apothecia and larger ascospores. *Rinodina occulta* has often been confused with *R. interpolata*, a species with similar habit but lacking atranorin (see also comments under those taxa).

Ecology and distribution: The only collection from the Benelux (Luxembourg) is from schistose rock, in a locality situated in an isolated hill covered by *Fraxinus, Quercus* and *Sorbus* trees. Other species occurring there were e.g. *Haematomma ochroleucum, Pertusaria corallina, Rhizocarpon badioatrum, R. geographicum* s.l., *R. viridiatrum, Scoliciosporum umbrinum, Trapelia involuta* and *Xanthoparmelia mougeotii.*

Additonal specimen examined: **LUXEMBOURG**: Region Oesling: E of Esch-sur-Sûre, rocks above tunnel, near top of hill, on schistose rock, 310 m, 21.9.1986 (MB-15532).

16. *RINODINA OLEAE* BAGL.

Mem. Reale Accad. Sci. Torino, ser 2, **17**: 403 (1857).- Type: Italy, Liguria, Genova, Valletta di Granarolo, on *Olea europaea*, 1857, F. Baglietto (M, MARSSJ, RO, W-isotypes!, as Anzi: Lich. Lang. 304; M, RO, WU-isotypes!, as Erb. Critt. Ital. 35).

(Fig. 6C)

Further information: MAGNUSSON (1947), LAMBINON (1969, as *R. exigua*), HUNECK & FOLLMANN (1970), BRAND & al. (1988, as *R. exigua*) and GIRALT & MAYRHOFER (1995).

Thallus continuous, thin and smooth to minutely granulose-verrucose, whitish grey, greenish grey to shade grey. Apothecia lecanorine, sessile, 0.2-0.5(-0.7) mm diam, sometimes becoming pseudolecanorine. Thalline margin concolorous with thallus, usually persistent. Disc plane to subconvex, dark brown to black. Hymenium 60-80 µm high. Epihymenium dark brown. Asci *Lecanora*-type. Ascospores *Dirinaria*-type, 13-18 x 6-9 µm, swelling around the septum with KOH, torus not or poorly developed. Ascospore-ontogeny of type B.

Chemistry: No substances detected by TLC (GIRALT & MAYRHOFER 1995).

Discussion: The lack of secondary lichen compounds, small, abundant and confluent apothecia together with the *Dirinaria*-type ascospores are diagnostic of this species.

Rinodina exigua has often been confused with *R. oleae*. Its content of atranorin and its *Physcia*-type ascospores are distinguishing characters. See also comments under *R. gennarii*.

Ecology and distribution: *Rinodina oleae* is one of the most frequent corticolous *Rinodina* species in the Benelux. It grows on bark of *Acer, Betula, Juglans, Populus, Quercus* and *Salix*. It occurs mostly in nutrient-enriched or dusty locations where it usually forms small thalli in association with other nitrophilous species such as *Amandinea punctata, Candelariella aurella, Lecanora dispersa, L. hagenii, Phaeophyscia orbicularis, Strangospora pinicola* and *Xanthoria parietina*. *R. oleae* is rather common in the Netherlands, rare in western and central Belgium but it was not found in the upland of eastern Belgium and Luxembourg. This distribution seems to indicate that it is a maritime species. The closely related *R. gennarii* presents a wider distribution in the Benelux, being also common in upland areas. *R. oleae* was already reported from the studied area by LAMBINON (1969) and BRAND & al. (1988) as *R. exigua*. It is hitherto not known from Luxembourg.

Selected specimens examined: **BELGIUM**: Prov. West-Vlaanderen: Blankenberge, sur escalier en bois appliqué sur la digue du petit port, 17.6.1967, J. Lambinon-67/B/401 (LG).- Prov. Oost-Vlaanderen, S of Gent, Merelbeke, on *Populus,* 17.8.1954, J. Barkman-4621 (L).- Prov. Antwerpen: ENE of Turnhout, Schuurhovenberg, reserve 'Lierman', scattered trees, on *Betula,* 21.8.1993 (PB-15050).- Prov. Brabant: area of Vollezele, on conifer, 30.7.1962 (LG). **THE NETHERLANDS**: Prov. Friesland: Gaasterland, Oude Mirdumerklif, dike along Ijsselmeer, on wood, 5.10.1990 (AA-27005).- Prov. Groningen: Waddensea island Rottumerplaat, on wood of cabin, 28.5.1977, P.v.d.Knaap (AA).- Prov. Noord-Holland: near Amsterdam, on wood of fence, 1.1849, C. v.d. Sande Lacoste (L). Schoorl, on *Ulmus* along road, 22.5.1977 (AA-1963). Haarlem, Duin en Kruidberg, on *Populus,* 2.5.1982 (AA-9862). Assendelft, on wood of fence along brackish water, 15.1.1987 (AA-17045). W of Haarlem, Overveen, Kraantje Lek, on *Populus* on steep slope of dunes, 12.11.1989 (MB-21121). Heemskerk, Jan van Kuikweg, on *Salix,* 2.2.1990 (AA-26762). N of Amsterdam, 1 km E of Landsmeer, on *Populus,* 28.5.1992 (AA-28590).- Prov. Zuid-Holland: Voorne, Brielle, on exposed *Ulmus,* 1.5.1953, J. Barkman-4161 & R. Maas Geesteranus-9336 (L). Rotterdam, Zuiderpark, on *Populus,* 21.5.1986, P.v.d.Knaap (U).- Prov. Utrecht: Utrecht, on wood of old fence, 1841, C. v.d. Sande Lacoste (L). Rhenen, on *Aesculus* in the city, 9.9.1989 (AA-26592). Oud-Loosdrecht, on wooden pale in water, 23.2.1994 (AA-33851).- Prov. Zeeland: Goes, on old wooden fence, 1850, R. v.d. Bosch (L).- Prov. Noord-Brabant: St. Oedenrode, Nijnsel, on *Populus,* 22.5.1984 (PB-1364). N of Lieshout, Mariahout, on *Acer,* 14.4.1986 (PB-3376). Vessem, road Hoogeloon-Baarschot, on *Betula,* 2.7.1987 (PB-5662). SE of Nuenen, Vaarle, on *Juglans,* 16.2.1988 (PB-6298). E of Eindhoven, E of Steensel, path in *Pinus* wood, on *Betula,* 31.8.1992 (PB-13651). NNW of Nuenen, Spekt, roadside trees, on *Quercus,* 3.10.1993 (PB-15139). SSE of Tilburg, W of Hilvarenbeek, Groot Loo, on roadside *Salix,* 30.4.1993 (PB-14026). SE of Heeze, Sterksel, on mature *Populus,* 9.10.1993 (PB-15156, 15158).

17. *RINODINA OXYDATA* S. LAT.

The following description is based on material from the studied area and includes characters of *Rinodina vezdae* Mayrhofer. For further explanations see the discussion given below.

(Figs. 4A, 6D)

Further information: SHEARD (1967), HECKLAU & al. (1981), MAYRHOFER & POELT (1979), MAYRHOFER (1984a-b, 1987), BRAND & al. (1988), FOX & PURVIS (1992), V.D. BOOM & al. (1994b), GIRALT & BARBERO (1995) and MATZER & MAYRHOFER (1996).

Thallus thin, rimose or of discrete, plane and smooth areolae, whitish, ochraceous or pale grey. Prothallus black, usually present. Apothecia cryptolecanorine to lecanorine and ±immersed, often becoming pseudolecanorine and adnate, usually scattered, up to 0.8 mm diam. Thalline margin concolorous with thallus, thin, usually becoming excluded. Proper margin dark brown to black, persistent, usually darker than the disc,

in section often with a greenish black pigment reacting N+ reddish. Disc plane to subconvex, brown. Hymenium 70-110 µm high. Epihymenium brown. Asci variable, of *Lecanora*-type or intermediate between the *Lecanora*- and the *Bacidia*-type. Ascospores *Mischoblastia*-type, 18-28 x 8-14 µm, torus poorly developed. Ascospore-ontogeny of type A.
Chemistry: Thallus and thalline margin of the apothecia (when present) K+ and PD+ yellow; atranorin by TLC.

Discussion: As it was already noted in GIRALT & BARBERO (1995) and according to MATZER & MAYRHOFER (1996), *Rinodina oxydata* should be treated as a species aggregate until a thorough world-wide revision is carried out. The characters used for the delimitation of the different species of the aggregate, such as thallus development, apothecial type (cryptolecanorine, lecanorine or pseudolecanorine) and ascospore size, are not constant and show a wide range of variability. *R. vezdae* Mayrhofer is also included here, a species with well developed thalli, large cryptolecanorine to lecanorine apothecia which usually do not become pseudolecanorine and with a majority of ascospores larger than 25 x 14 µm. One of the specimens examined (Lambinon-66/B/160, LG) has ascospores like *R. vezdae* but, on the other hand, it shows a poorly developed thallus and pseudolecanorine apothecia, both features fitting better with *R. oxydata* s. str. In contrast, specimens with ascospores not larger than 25 x 14 µm, like in *R. oxydata* s. str., can possess thalline and apothecial characters typical of *R. vezdae*. Despite of all, we refrain from putting the species into synonymy.
Under *Rinodina oxydata* s. lat. we have included specimens with thallus containing only atranorin, cryptolecanorine to lecanorine apothecia which often become pseudolecanorine and large *Mischoblastia*-type ascospores.
Rinodina teichophila, another saxicolous species occurring in the studied area with large, *Mischoblastia*-type ascospores, can be readily separated from *R. oxydata* by the better developed, thicker and darker thallus which furthermore lacks atranorin (compare MATZER & MAYRHOFER 1994).

Ecology and distribution: In the studied area, *R. oxydata* occurs mostly on dikes which probably at times of high flow are inundated. In this habitat, associated species are scarce but sometimes *R. oxydata* occurs along with *Caloplaca atroflava, C. subpallida* and *Lecanora muralis.* In the Netherlands it was only found on dikes along rivers in moderately shaded and sheltered situations. One collection from Luxembourg (PB-12453, MB-27227) is from a boulder in a stream and was growing beside *Aspicilia aquatilis, Caloplaca subpallida, Catillaria atomarioides, Lecanora achariana* and *L. muralis.* Hitherto, only one collection was reported from Belgium (MAYRHOFER 1984a) and from the Netherlands (Brand & al. 1988), and two localities were known from Luxembourg (v.d. Boom & al. 1994b). Recent discoveries of *R. oxydata* in the Netherlands are the result of the study of the threatened dikes which will be raised in a short time as a consequence of the floods of winter 1994-95.

Specimens examined: **BELGIUM**: Prov. Luxembourg: rive droite de l'Ourthe sous Macouray (aux confins de Marcourt et Hodister), rochers schisteux subverticaux très humides par périodes, 17.4.1966, J. Lambinon-66/B/160 (LG). **LUXEMBOURG**: Region Oesling: E of Esch-sur-Sûre, near tunnel on road N15, on shale, 300 m, 2.5.1992 (AA-28839, PB). N of Bigonville, Moulin de Bigonville, E of Hotel, boulder in stream, horizontal surface, 2.5.1992 (PB-12453, MB-27227). **THE NETHERLANDS**: Prov. Utrecht: Lopik, along 'Lek', S exposed dike, on basalt, 1.10.1987 (MB-19809).- Prov. Gelderland: E of Waardenburg, Neerijnen, S exposed sloping dike along 'Waal', on basalt, 1.4.1995 (PB-16744, 16738, AA-35695). E of Waardenburg, E of Opijenen, S exposed dike along Heesseltsche Uiterwaarden, on basalt, 1.4.1995 (PB-16747). Ibid., Varik, S exposed sloping dike along 'Waal', on basalt, 1.4.1995 (PB-16758).

18. *RINODINA PITYREA* ROPIN & H. MAYR.

Bibliotheca Lichenologica **58**: 374: (1995).- Type: Switzerland, Genf: Carouge S Genf, on *Populus nigra,* 3.1883, J. Rome (G-holotype, G-isotype, not seen).

(Fig. 1C)

Further information: Magnusson (1947), Sheard (1967), Fox & Purvis (1992) and v.d. Boom & al. (1994a), as *R. colobina*; Ropin & Mayrhofer (1995) and Giralt (1994).

Thallus continuous, first thin and smooth then becoming entirely blastidiate and forming a continuous leprose crust, blue-green to blue-grey. Blastidia small, up to 30 µm diam. Apothecia lecanorine, sessile, 0.3-0.6 mm diam. Thalline margin concolorous with thallus. Disc plane, dark brown to black. Hymenium 75-85 µm tall. Epihymenium blue-grey. Asci *Lecanora*-type. Ascospores *Tunicata*-type, 14-21 x 7-12 µm, torus absent. Ascospore-ontogeny of type B.

Chemistry: Thallus, blastidia and epihymenium K+, C+ and N+ violet. No substances detected by TLC.

Discussion: The leprose thallus (entirely blastidiate) and, especially, the blue-grey epihymenium which reacts K+, N+ and C+ violet and the *Tunicata*-type ascospores are diagnostic of *R. pityrea*. Among the species treated it is unique in having those features. *R. pityrea* has often been confused with the closely related *R. colobina*. However, the latter is readily separated by its ascospores with an ontogeny from *Pachysporaria*- to *Physcia*- and then to *Mischoblastia*-type (compare ROPIN & MAYRHOFER 1995).

Ecology and distribution: *Rinodina pityrea* is known as saxicolous as well as corticolous. It grows most frequently on eutrophic substrata, where it forms sterile or fertile thalli among other nitrophilous species such as *Caloplaca phlogina* and *Lecania cyrtella*. From the Netherlands, it was already reported as *R. colobina* by V.D. BOOM & al. (1994a). Hitherto, it is not known from Belgium and Luxembourg.

Specimens examined: **THE NETHERLANDS**: Prov. Noord-Holland: Alkmaar, Noordervaart, 'Stompetoren' stump of *Ulmus* (MB-20459)- Prov. Drente: ENE of Dwingeloo, Holtien, on wood, 24-8-1991 (MB-26564).- Prov. Overijssel, Kampernieuwstad, in garden, on decorticated part of *Ulmus*, 30.4.1983 (MB-10669).- Prov. Zuid-Holland: E of Hoogmade, dike of Wijde, 4.1988 (MB-17713, saxicolous).

19. *RINODINA PYRINA* (ACH.) ARNOLD

Flora **64**: 196 (1881).- Type: Locality not indicated (BM-ACH-lectotype!).

Further information: MAGNUSSON (1947), MAYRHOFER (1987), STEINER & MAYRHOFER (1987), BRAND & al. (1988), DIEDERICH (1989), DIEDERICH & al. (1991), FOX & PURVIS (1992), ROPIN & MAYRHOFER (1993), GIRALT (1994) and GIRALT & MAYRHOFER (1995).

Thallus thin, minutely granulose-verrucose, whitish grey to shade grey. Apothecia lecanorine, adnate to sessile, confluent, 0.2-0.4(-0.5) mm diam. Thalline margin concolorous with thallus, usually persistent. Disc plane to convex, dark brown to black. Hymenium 40-75 µm high. Epihymenium dark brown. Asci *Lecanora*-type. Ascospores *Physconia*-type, 12-15 x 5-7 µm, torus not or poorly developed. Ascospore-ontogeny of type A.
Chemistry: No substances detected by TLC (GIRALT & MAYRHOFER 1995).

Discussion: *Rinodina pyrina* is characterized by its thin thallus lacking lichen compounds, its small, abundant and confluent apothecia and its small *Physconia*-type ascospores. *R. archaea*, the other corticolous species with the same ascospore-type, is mainly separated by its significantly larger ascospores which, furthermore, always show a well developed torus (see also comments under *R. archaea*).

Ecology and distribution: Most collections of *Rinodina pyrina* from the Benelux are from the last century and were previously reported by BRAND & al. (1988). They were mainly collected in coastal areas of the Netherlands and often occur in association with *Caloplaca haematites*. In one of the specimens examined, other species found growing together are *Arthonia galactites, A. muscigena, A. radiata, Caloplaca cerinella, Diplotomma alboatrum, Lecanora carpinea, Lecidella elaeochroma, Physcia adscendens, P. tenella* and *Xanthoria parietina*. Only single collections are known from Belgium and Luxembourg. That from Belgium dates from this century and was growing on *Aesculus*, in the southeastern part of the country, along with *Physconia grisea* and *Xanthoria* sp. That from Luxembourg dates from the last century and was already mentioned by DIEDERICH (1989) and DIEDERICH & al. (1991). The record in WERNER (1962) is wrong and refers to *R. archaea*.

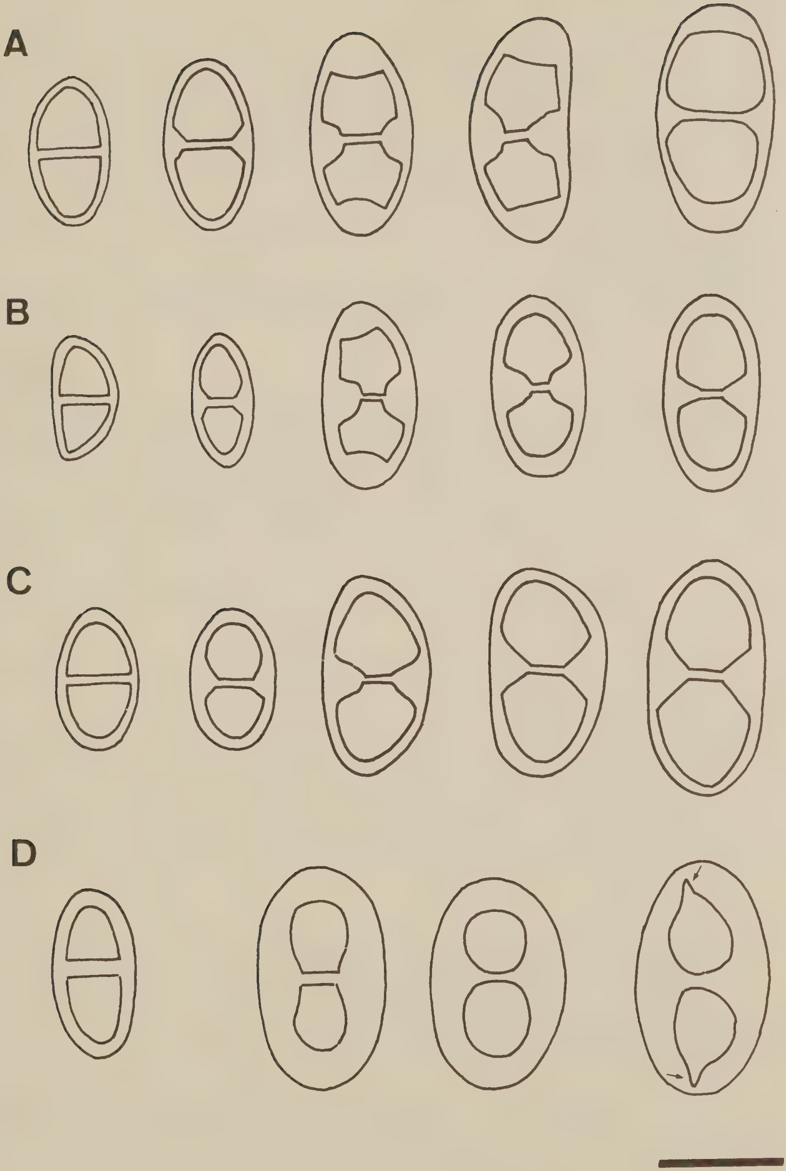
Additional specimens examined: **BELGIUM**: Prov. Luxembourg: SE of Arlon, Autelbas, on *Aesculus*, 28.9.1965, J. Lambinon-65/B/769 (LG). **LUXEMBOURG**: Locality not indicated, c. 1840, Tinant-487a (LUX). **THE NETHERLANDS**: Prov. Zeeland: Zuid-Beveland, on trunk of *Populus* 6.1845, R. v.d. Bosch (L).- Prov. Noord-Holland: near Amsterdam, Vermeerpad, on *Fraxinus*, 1.1849, C. v.d. Sande Lacoste (L).- Prov. Zuid-Holland: Scheveningen, 1852, (L).

20. *RINODINA SICULA* H. MAYRHOFER & POELT

Bibliotheca Lichenologica **12**: 143 (1979).- Type: Italy, Sicilia, Messina, Monti Nebrodi, M. Trefinaite, Borgo Piedrapizzuta, 960-1100 m, 1.5.1978, Hertel & Hertel (M-holotype!, GZU-isotype!).

(Fig. 3C)

Fig. 3.- A-D: Ascospore-ontogeny of type A: **A.** *Physcia*-type ascospores of *R. confragosa* (PB-15240). **B.** *Physcia*-type ascospores grading into the *Physconia*-type when mature of *R. interpolata* (PB-9457). **C.** *Physconia*-type ascospores of *R. sicula* (AA-28721). **D.** *Pachysporaria*-type ascospores of *R. atrocinerea* (MB-14368) (arrows: protrudings towards the spore-ends).


A
B
C
D

Further information: MAYRHOFER & POELT (1979), MAYRHOFER (1984a, 1987), MAYRHOFER & LEUCKERT (1985) and V.D. BOOM & al. (1994b, as *R. interpolata*).

Thallus thin, rimose-areolate, continuous, pale to dark grey. Prothallus present or absent. Apothecia lecanorine, abundant and confluent, adnate to sessile, up to 0.5 mm diam. Thalline margin thin, entire, persistent. Disc dark brown to black, plane to subconvex. Hymenium up to 110 µm high. Epihymenium reddish brown. Asci *Lecanora*-type. Ascospores *Physconia*-type, (14-)16-18(-20.5) x 8-10 µm, torus well developed. Ascospore-ontogeny of type A.
Chemistry: thallus and thalline margin of the apothecia C+ red; zeorin (traces, not always), gyrophoric, lecanoric and orsellinic (traces) acids by TLC.

Discussion: *Rinodina sicula* is characterized by its pale to dark grey thallus containing gyrophoric and lecanoric acid, its small, abundant and confluent lecanorine apothecia and its typical *Physconia*-type ascospores with a very well developed torus. According to MAYRHOFER & POELT (1979) and MAYRHOFER (1984a, 1987), *R. sicula* possesses *Sicula*-type ascospores rather than *Physconia*-type. According to the same authors, both ascospore-types are distinguished by the presence of a torus (in *Sicula*-type) vs. absence (in *Physconia*-type). As it has already been noted (compare e.g. SCHEIDEGGER 1993, GIRALT 1994 and MATZER & MAYRHOFER 1996) the presence/absence of a torus should no longer be used for the definition of ascospore-types.
The specimen of *R. sicula* from Elba examined by TLC by MAYRHOFER & LEUCKERT (1985), does not contain lichen substances and must refer to another species. Our TLC analyses show that both the holotype (M) and the specimen cited below (Aptroot-28721) as well as two specimens from the Iberian Peninsula (VAB-2700, 2685) contain at least traces of gyrophoric and lecanoric acids.
Among the species treated, *R. sicula* is unique in having *Physconia*-type ascospores and the gyrophoric acid complex. *R. interpolata* and *R. occulta*, with *Physcia*-type ascospores grading into the *Physconia*-type when mature, are mainly distinguished by apothecia becoming pseudolecanorine and an alternative chemistry.

Ecology and distribution: The only collection of *R. sicula* known from the Benelux was misidentified as *R. interpolata* (V.D. BOOM & al. 1994b). It was collected in eastern Luxembourg, at roadside, on sandstone, in association with *Candelariella vitellina, Lecanora* cf. *pannonica* and an unidentified sterile crust.

Additional specimen examined: LUXEMBOURG: Region Gutland: 1.5 km SW of Berdorf, Binzeltschloeff, 340 m, 30.4.1992 (AA-28721).

21. *Rinodina sophodes* (ACH.) A. MASSAL.

Rich. Lich. Crost.: **14** (1852).- Type: Locality not indicated (BM-ACH-lectotype!).

Further information: MAGNUSSON (1947), SHEARD (1967), MAYRHOFER (1987), FOX & PURVIS (1992), ROPIN & MAYRHOFER (1993), V.D. BOOM & al. (1994a), GIRALT (1994) and GIRALT & MAYRHOFER (1995).

Thallus cracked-areolate, reddish-brown over a black prothallus. Apothecia lecanorine, immersed to adnate, up to 1 mm in diam. Thalline margin entire, thick, prominent and persistent. Disk dark brown, plane. Apothecial cortex thick, I+ blue. Hymenium up to 100 µm high. Epihymenium reddish brown. Asci of *Lecanora*-type. Ascospores of *Milvina*-type, 10-17 x 6.5-9 µm, constricted at the septum, torus well developed. Ascospore-ontogeny of type A.

Chemistry: No substances were detected by TLC (GIRALT & MAYRHOFER 1995).

Discussion: *Rinodina sophodes* is well characterized by the reddish brown thallus over a black prothallus lacking secondary lichen compounds, the thick apothecial cortex which reacts I+ blue and the *Milvina*-type ascospores, constricted at the septum and which possess always a well developed torus. There is only one collection of *R. sophodes* from the Benelux. Although the specimen is in a very bad condition, the diagnostic characters mentioned above were at least in part visible, and the species has been included in the present contribution.

Ecology and distribution: The single collection known from the Benelux was found growing on smooth bark of a twig of *Quercus,* in a small wood of a dune area of Vlieland Island, in association with other pioneer species such as *Lecanora chlarotera* and *Lecidella elaeochroma*. The specimen was already reported by V.D. BOOM & al. (1994a). *R. sophodes* is not known from Belgium and Luxembourg.

Additional specimen examined: **THE NETHERLANDS**: Prov. Friesland: Waddensea island Vlieland, Oude Kooi, on *Quercus,* 1948, R. Maas Geesteranus-4041 (L).

22. *RINODINA TEICHOPHILA* (NYL.) ARNOLD

Flora **46:** 329 (1863).- Type: Mudd. Lich. Brit. exs. 108 (BM-isotype, not seen).

(Figs. 4B, 9)

Further information: SHEARD (1967), LAMBINON (1969), HUNECK & FOLLMANN (1970), FOLLMANN & HUNECK (1972), MAYRHOFER & POELT (1979), MAYRHOFER (1983, 1984a, 1987), LEUCKERT & MAYRHOFER (1984), BRAND & al. (1988), FOX & PURVIS (1992), MATZER & MAYRHOFER (1994).

Thallus thick, rimose-areolate to areolate. Areolae smooth to granulose-verrucose, pale to dark grey to brownish. Apothecia lecanorine, immersed to adnate, up to 1 mm diam. Thalline margin entire, persistent, concolorous with thallus. Proper margin often visible as a ring within the thalline margin. Disc plane to convex, dark brown to black. Hymenium up to 125 µm high. Epihymenium reddish brown. Asci *Lecanora*-type. Ascospores *Mischoblastia*-type, when mature showing tendencies towards the *Pachysporaria*-type, 18-28 x 10-15 µm, swelling around the septum with KOH, torus absent. Ascospore-ontogeny of both types, A or B.
Chemistry: No substances detected by TLC. Traces of atranorin were detected by mass spectrometry by LEUCKERT & MAYRHOFER (1984). According to the same authors, the presence of atranorin reported by HUNECK & FOLLMANN (1970) refers to *R. vezdae* and the report of atranorin and α-collatolic acid given in FOLLMANN & HUNECK (1972) is doubtful.

Discussion: *Rinodina teichophila* is characterized by its thick and rimose-areolate thallus, the lack of spot test reactions, its large lecanorine apothecia and its large *Mischoblastia*-type ascospores swelling around the septum in KOH. *Rinodina oxydata* s. lat. differs by the thinner and smoother thallus which, furthermore, contains atranorin, the lecanorine to pseudolecanorine apothecia and the *Mischoblastia*-type ascospores which do not swell around the septum with KOH (compare MATZER & MAYRHOFER 1994).

Ecology and distribution: Most collections of *R. teichophila* from the Benelux where found in the Netherlands. It usually grows on dikes along rivers but it also occurs on brick and mortar walls, where it often forms extensive patches along with *Lecanora dispersa, Phaeophyscia orbicularis* and *Xanthoria parietina.* Whereas the species shows a wide distribution in the Netherlands (Brand & al. 1988), it is only known from one locality in southern Belgium (compare Lambinon 1969). Two other specimens (Lambinon-66/B/160 and Lambinon-62/B/910) from Belgium mentioned by the last author do not correspond to *R. teichophila* but to *R. oxydata* s. lat. and to an unidentified sterile crust, respectively. *R. teichophila* is not known from Luxembourg.

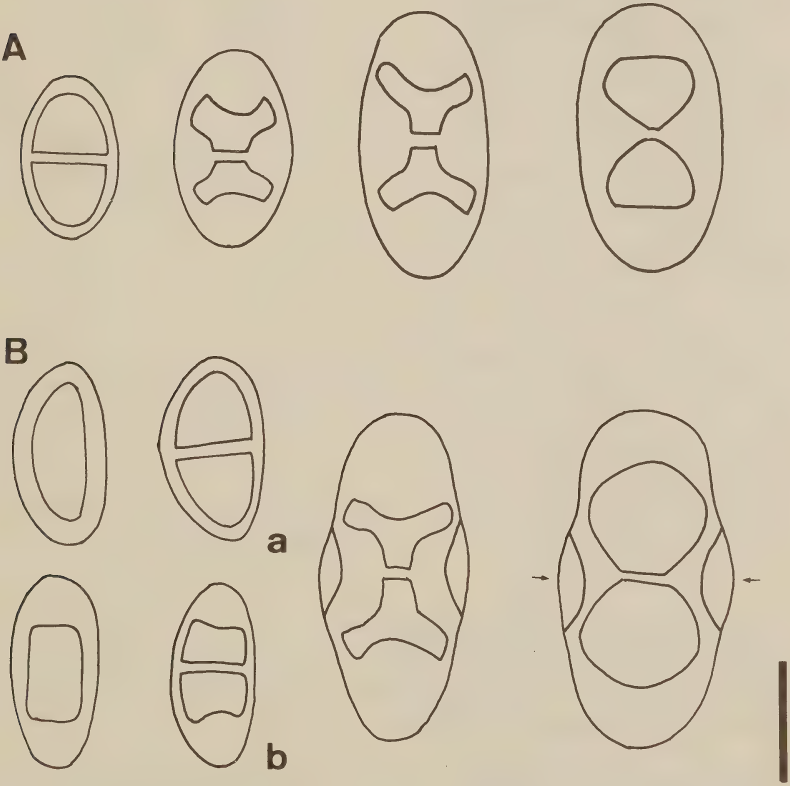


Fig. 4.- A: *Mischoblastia*-type ascospores of *R. oxydata* (PB-16744) following an ascospore-ontogeny of type A. **Ba-b.** *Mischoblastia*-type ascospores of *R. teichophila* (PB-9201) following an ascospore-ontogeny of both types, A **(a)** or B **(b)** (arrows: swellings around the septum).

Selected samples examined: **BELGIUM**: Prov. Namur: WNW of Dinant, Sosoye, Rochers de Sosoye, on S exposed calcareous rock, 30.7.1962, J. Lambinon-2/B/917 (LG). **THE NETHERLANDS**: Prv. Friesland: Gaasterland, Stavoren, NW exposed dike, on granite, 23.9.1989 (PB-9201).- Prov. Groningen: ESE of Delfzijl, Oterdum, dike along Eems, on N exposed calcareous stones, 9.9.1990 (PB-10137).- Prov. Noord-Holland: E of Amsterdam, Diemen, Zeeburgerdijk, dike along Ijsselmeer, on N exposed granite, 14.6.1987 (MB 16988).- Prov. Gelderland: E of Waardenburg, Neerijnen, S exposed dike along Rijkswaard, on basalt, 1.4.1995 (PB-16737).- Prov. Zeeland: Schouwen, Burgh-Haamstede, brick wall along church, on brick, 7.5.1988 (PB-6805).- Prv. Noord-Brabant: NW of Den Bosch, Engelen, brick wall along church, on mortar, 9.11.1989 (PB-9275)

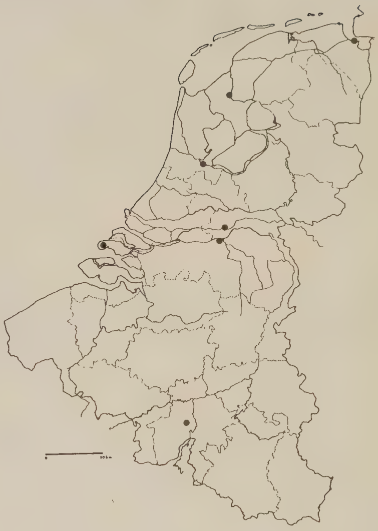


Fig. 5.- Distribution of *Rinodina teichophila* (Nyl.) Arnold.

23. *Rinodina tunicata* H. Mayrhofer & Poelt

Bibliotheca Lichenologica **12:** 153 (1979).- Type: Italy, Sicily, Enna, Mte. Cane, ca. 8 km NW of Pietraperzia, "Miniti", 400-500 m, 23.4.1978, Hertel & Hertel-19261 (M-holotype, GZU-isotype!).

Further information: Mayrhofer & Poelt (1979), Sérusiaux & al. (1983, as *R. calcarea*) and Mayrhofer 1984a, 1987).

Thallus usually indistinct (endolithic or epilithic but inconspicuous), whitish to pale grey. Apothecia first lecanorine, rapidly becoming pseudolecanorine, immersed to sessile, 0.5-0.8 mm diameter. Thalline margin thin, concolorous

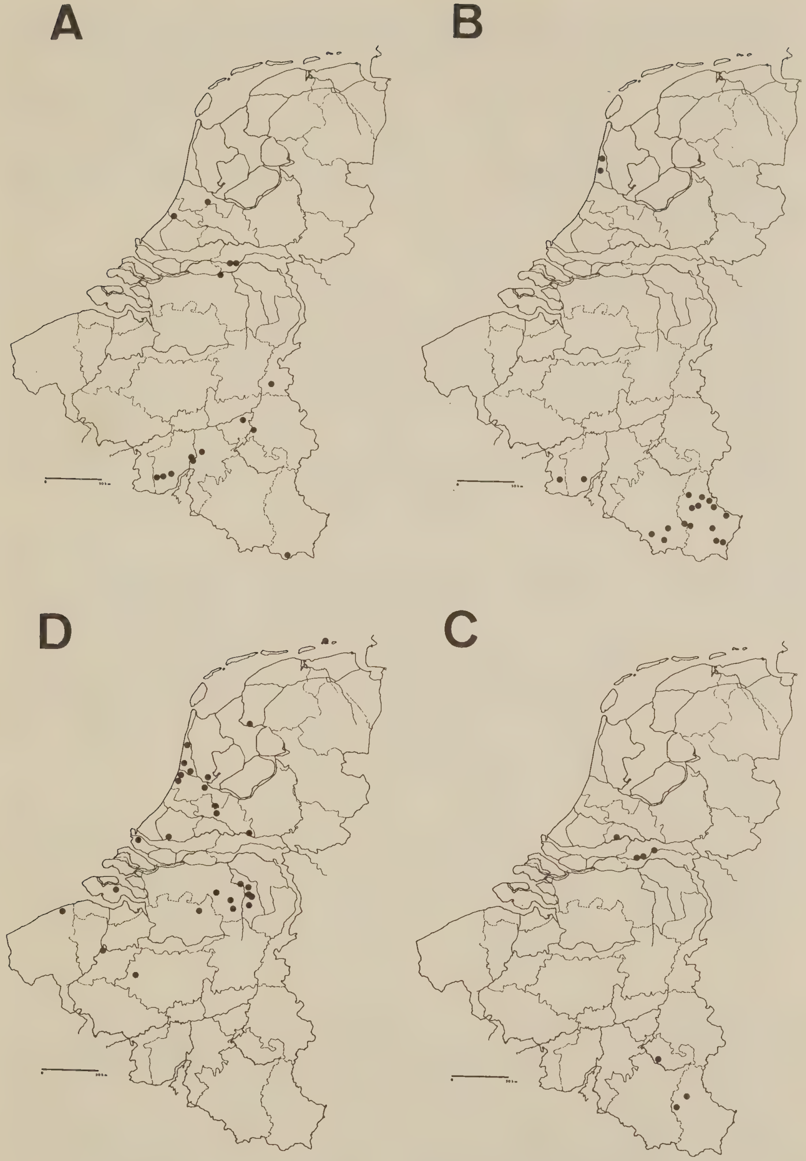


Fig. 6.- Distribution of: **A.** *Rinodina bischoffii* (Hepp) Massal. **B.** *Rinodina efflorescens* Malme. **C.** *Rinodina oleae* Bagl. **D.** *Rinodina oxydata* s. lat.

with thallus, rapidly completely excluded. Disc plane to subconvex, dark brown to black. Proper margin concolorous with disc, usually thick, entire and persistent. Excipulum with plenty of oil droplets. Hymenium up to 130 µm tall, often ±interspersed with oil droplets. Epihymenium reddish brown. Hypothecium interspersed with abundant oil droplets. Asci *Lecanora*-type. Ascospores *Tunicata*-type, 18-24 x 10-14 µm, torus absent. Ascospore-ontogeny of type A.
Chemistry: No substances detected by TLC.

Discussion: *Rinodina tunicata* is characterized by its indistinct to inconspicuous thallus, its pseudolecanorine apothecia ±immersed in the substratum at the beginning, its interspersed excipulum, hymenium and hypothecium and its *Tunicata*-type ascospores. *R. immersa* and *R. dubyana* are similar in appearance but have *Bischoffii*- and *Physconia*-type ascospores, respectively. *R. calcarea* and *R. pityrea* which also possess *Tunicata*-type ascospores are readily distinguished by several morphological characters (see comments under those taxa).

Ecology and distribution: In the Benelux, *R. tunicata* is only known from the southern part of Belgium. It grows on calcareous rocks, usually forming well developed and abundantly fertile thalli in association with *Aspicilia calcarea, A. contorta, Caloplaca aurantia* and *Leptogium schraderi. R. tunicata* was previously reported from the same area by MAYRHOFER (1984a). The record of *R. calcarea* in SÉRUSIAUX & al. (1983) refers to this species. It is not known from Luxembourg and the Netherlands.

Additional specimens examined: **BELGIUM**: Prov. Namur: N of Dinant, SSE of Yvoir, Poilvache, on a calcareous outcrop, 14.9.1989 (MB-21989). Dourbes, Roche-à-Lomme, vers le sommet, rocher calcaire ensoleillé, 1982, Sérusiaux-4651 & Malaise (LG). NE of Dinant, Fonds de Leffe, S exposed slope with calcareous outcrop, 180 m, 28.4.1984 (PB-1308a).

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STUDIES ON WESTERN AMERICAN PEZIZALES. COLLECTING AND DESCRIBING ASCOMATA— MACROSCOPIC FEATURES

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Collecting practices and suggestions for describing the macroscopic characters of Pezizalean ascomata are presented. They are based on studies of the Pezizales from the conterminous United States west of the Great Plains. New terms (athecium, exothecium, ptychothecium, pulverothecium, stereothecium) for several types of ascomata in the Pezizales are introduced. Athecia are undifferentiated clusters of asci and paraphyses on a weft of hyphae. In an exothecium, the exterior of the ascoma is covered by the hymenium; in a ptychothecium a distinct, typically convoluted, hymenium is partly to entirely enclosed; in a pulverothecium the asci develop within an initially hollow enclosed region and disintegrate at maturity, leaving a powdery spore mass; in a stereothecium the asci are clustered or scattered in a solid or slightly chambered/veined gleba completely enclosed by a peridium.

Key Words: types of ascomata, fungi, methods, morphology, Pezizales, symmetry.

1.00. INTRODUCTION

The Pezizales *emend.* Trappe are represented in western North America by 350-400 taxa. Larsen and Denison (1978) listed over 230 taxa of Pezizales, excluding most hypogeous forms. We estimate that about 100 taxa of "truffles" (hypogeous Pezizales) occur in the region; new records and new taxa of both epigeous and hypogeous taxa make up the balance. The order Pezizales includes a diverse set of fungi. The ascomata (ascoma, sing.) vary from hypogeous to epigeous, from microscopic to about 30 cm. tall, and from edible to poisonous (most are too small or too rare to consider as esculents). The nutritional requirements of many are unstudied; the order is known to include a few parasites, many saprobes, and many known or suspected mutualists. Some taxa fruit in a wide variety of habitats; others fruit in very specific and scattered microhabitats. The type of ascoma traditionally associated with the Pezizales is an open epigeous cup (an apothecium, Fig. 1:B).

For epigeous taxa, Seaver (1928, 1942), together with Pfister's (1982) update on nomenclature, provide the most extensive, though outdated, coverage for the region. Tylutki (1979) presents the most recent regional treatment, covering about 104 taxa and describing only those with ascomata at least 1.0 cm in diam. Gilkey's publications (1939, 1954) are the most extensive on the hypogeous taxa. Additional studies include several Master's theses (Brough, 1958; Hicks, 1965; Lusk, 1987; Tamm, 1978), a few Ph.D. theses (Gilkey, 1916; Larsen, 1975; Paden, 1967; Snyder, 1938) and papers too numerous to list. Korf's (1973) bibliography is a valuable resource for accessing taxonomic literature on the discomycetes and Pezizales through about 1972. Neither an updated bibliography nor a reasonably complete set of keys to the Pezizales *emend.* Trappe (1979) known from western North America has appeared in recent years.

The discussions of methodology for collecting, processing, and describing the ascomata of morels, truffles, and allied cup-fungi presented by Breitenbach and Kränzlin (1984), Castellano et al. (1989), Dennis (1978), Eckblad (1968), Korf (1973), Rifai (1968), and Tylutki (1979) provide a solid foundation for anyone contemplating detailed studies of these fungi. However, recent work, primarily on the Leotiales, e.g., Huhtenin (1989), and Baral (1992), plus our own observations have led us to reexamine the methodology and terminology used in studying the Pezizales. In this paper, we present techniques for collecting and handling specimens and for describing macroscopic features of the ascomata insofar as they differ from the advice offered in the publications listed above. Microscopic features will be considered in a later paper. It is time to heed Huhtenin (1994) and do our part "to promote methodological awareness in the study of discomycetous fungi" for the Pezizales.

The reexamination of methodology and terminology is a response to three trends that are influencing current studies on the western American Pezizales: 1) the evolving integrated approach to studies of the Pezizales, 2) the increasing use of computers to sort and compare data sets in taxonomic, phylogenetic, and cladistic analyses, and 3) the growing need for information on macrofungi expressed by those charged with managing public and private lands.

Similarities between the Tuberales and the Pezizales *sensu stricto* have been recognized for over a century (Tulasne and Tulasne, 1851). Gilkey (1939) suggested that the dividing line between the orders was not always clear, but she did not merge them. Burdsall's (1965) observation of active ascospore discharge in the truffle *Geopora cooperi* Harkn. was pivotal in swinging opinion toward the unity of the Tuberales and Pezizales. A formal amalgamation was not made, however, until Trappe (1979) emended several families of the Pezizales to include many "truffles" and transferred selected familes from the Tuberales to the Pezizales. The broad concept of the Pezizales has been implicitly or explicitly accepted in several publications, e.g., Burdsall (1968), Donadini (1986), Kimbrough et al. (1991), Li and Kimbrough (1994), Pfister (1984), Trappe (1989), Zhang (1991a, 1991b, 1992a, 1992b) and Zhang and Minter (1989a, 1989b). However, several papers on the genus *Tuber* F.H. Wigg. describe significant differences in the structure of ascomata and patterns of ascus development from that reported for many Pezizales, e.g., Janex-Favre and Parguey-Leduc (1980, 1983, 1985, 1988), Parguey-Leduc and Janex-Favre (1977, 1981), Parguey-Leduc, Janex-Favre, and Montant (1987, 1990, 1991), Parguey-Leduc, Janex-Favre, Montant, and Kulifaj (1988, 1989), and Parguey-Leduc, Montant, and Kulifaj (1987). Brummelen (1994) cited these papers when he suggested maintaining the Tuberales as a monotypic order for *Tuber*. In contrast, Landvik and Eriksson (1994) proposed, on the basis of studies of 18S rDNA, that *Tuber* and *Elaphomyces* Nees might be ingroups in the Pezizales. Trappe (1979) proposed the Elaphomycetales for *Elaphomyces* in recognition of its unique combination of characters.

In spite of a general trend toward employing an expanded concept of the Pezizales, much of the recent descriptive literature still reflects the traditional dichotomy in methodology and terminology used to describe hypogeous taxa (truffles) *versus* epigeous taxa (morels and allied cup-fungi). Descriptions of the two groups seem to be written in different "dialects." As part of our emerging synthesis of the epigeous and hypogeous Pezizales of western North America, we propose that a common approach and integrated terminology be used when describing ascomata of the Pezizales.

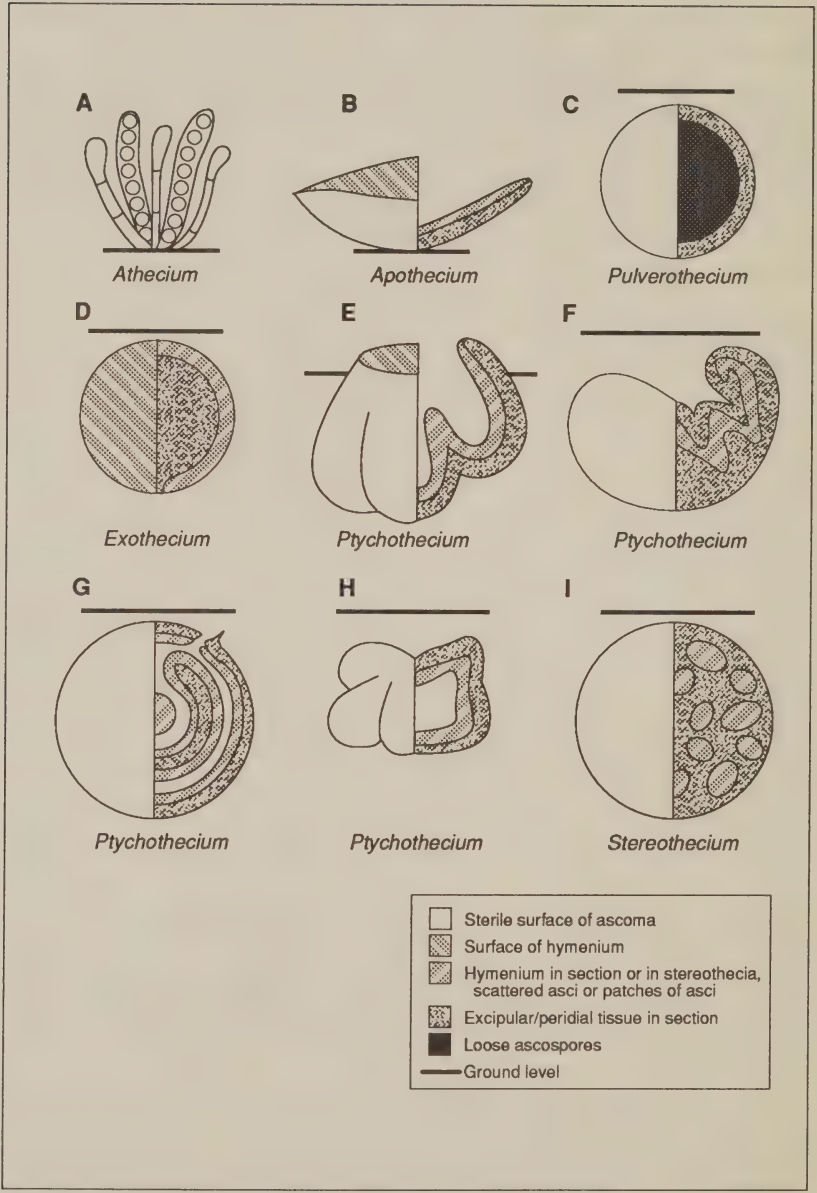
A
Athecium
B
Apothecium
C
Pulverothecium
D
Exothecium
E
Ptychothecium
F
Ptychothecium
G
Ptychothecium
H
Ptychothecium
I
Stereothecium
Sterile surface of ascoma
Surface of hymenium
Hymenium in section or in stereothecia, scattered asci or patches of asci
Excipular/peridial tissue in section
Loose ascospores
Ground level

Figure 1. Selected types of ascomata in the Pezizales. A, athecium; B, apothecium; C, pulverothecium; D, exothecium; E, F, G, H, ptychothecia; I, stereothecium.

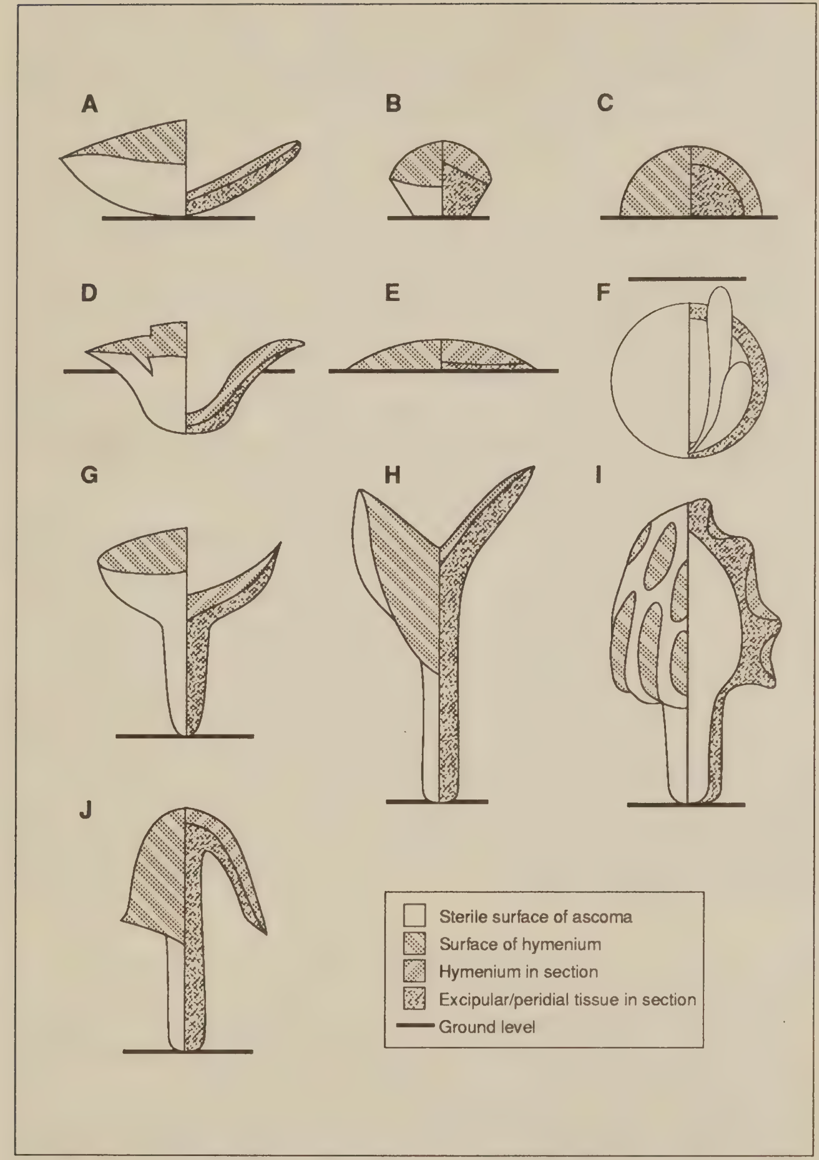
A
B
C
D
E
F
G
H
I
J
Sterile surface of ascoma
Surface of hymenium
Hymenium in section
Excipular/peridial tissue in section
Ground level

Figure 2. Selected types of apothecial ascomata in the Pezizales. A, B, C, D, E, astipitate apothecia; F, cleistohymenial apothecium; G, H, J, stipitate apothecia; I, stipitate morchelloid apothecium.

The use of computers in taxonomy and systematics, especially such programs as DELTA (Dalwitz and Paine, 1986), PAUP (Swofford, 1991), and MacClade (Maddison and Maddison, 1992) is another force behind this reexamination of methods and terminology. Characters and character states for morphological and anatomical features need to be defined and described with care before this data can be encoded for computer applications and have the resulting analyses be meaningful. Schumacher (1990) provides a good example of careful consideration of characters and character states. Well-documented specimens increase the likelihood that accurate identifications of the material can be made. Not only are vouchers important in taxonomy and systematics, they are also important for studies at the molecular level where correlation of morphological and molecular data is an objective. As species complexes are identified and resolved, the need for complete data on the voucher specimens may well become critical if earlier work is to remain useful. Precision in recording data on the characters of fresh ascomata is a prerequisite to making accurate identifications.

As biodiversity and ecosystem management come to the attention of the scientific community and general public, land managers are discovering a need to develop an understanding of groups of organisms that may have received little or no attention in past years. For example, 32 members of the Pezizales and 3 of *Elaphomyces* are among the 203 non-lichenized fungi listed as "Species to be protected through survey and management standards and guidelines" in Table C-3 of "Standards and Guidelines for Management of Habitat of Late-Successional Forests" (USDA Forest Service and USDI Bureau of Land Management, 1994b), a supplement to the "Record of Decision" (USDA Forest Service and USDI Bureau of Land Management, 1994a) arising out of considerations pertaining to the management of public lands in the range of the northern spotted owl (FEMAT, 1993).

2.00. FIELD TECHNIQUES

2.10. COLLECTING EQUIPMENT AND SUPPLIES. Collecting and annotating specimens so that they can be accurately identified is the primary focus of field work—almost all other studies depend on accurate identifications of the organisms involved. Techniques for collecting and handling specimens differ somewhat between epigeous and hypogeous Pezizales but have the common goal of obtaining complete, intact specimens and transporting them to the laboratory unspoiled. In all cases, collections should be kept cool and out of sunlight to prevent overheating and decomposition. Plastic wraps provide little protection from breakage; they may seal too tightly and create conditions favoring spoilage. While truffle ascomata and those of some hibernal Sarcosomataceae may continue to develop after collection if kept cool and moist, those of many taxa deteriorate within 24 hours of collection despite careful handling.

2.11. Epigeous ascomata. The ascomata of most epigeous taxa are large enough to be noticed in the field by observant collectors willing to crawl around in suitable habitats. Small-to-minute ascomata may be sought in various ways. Suitable substrates, e.g., herbivore dung or colonies of bryophytes and liverworts with their substrate, may be gathered and brought back to the laboratory for examination under a stereomicroscope. Dung is often incubated in damp chambers in order to observe the succession of taxa (Bell, 1983). Seasonal differences in the mix of taxa on dung have been observed: dung gathered in the late fall and winter often hosts taxa that are scarce to absent at other times of the year (Wicklow and Malloch, 1971). Bryophytes and liverworts may be colonized by some Pezizales (Döbbeler, 1979, 1980, 1988; Döbbeler and Itzerott, 1981) while others may fruit among, but are not visibly attached to, bryophytes and liverworts, e.g. *Selenaspora guernisacii* (P. & H. Crouan) R. Heim & Le Gal (Weber, 1995).

Most ascomata of epigeous taxa are fragile and subject to rapid desiccation. For small epigeous ascomata (roughly <3 cm in diam) several sizes of closable, rigid containers are useful. Moss or other vegetation may be added to maintain high humidity and cushion the specimens. Larger or sturdier specimens should be wrapped in waxed paper twists or aluminum foil. Waxed paper is preferable when specimens are wet and some moisture must escape in order to keep them from "stewing." Aluminum foil holds in moisture and is particularly useful when the specimens might otherwise dry out.

2.12. Hypogeous ascomata. Hypogeous ascomata can be difficult to find even though locally abundant. Usually they develop among the feeder rootlets of shrubs and trees near the interface of the humus and mineral soil, although occasionally they may be erumpent or more than 10 cm below the surface.

Animals locate hypogeous fungi by their odor, dig them up, and eat them. The pits or scrapings left by this activity indicate the presence of a colony of a hypogeous fungus. Often a colony produces many ascomata, and the animal mycophagists may leave specimens for later harvest. Raking the humus and upper mineral soil for about 0.5 m around fresh animal digs often yields specimens. With persistence and patience, the collector builds experience on where and when to look. **Humus raked away from a spot should always be replaced to protect the colony and the roots.**

When raking, the collector cannot know what will be found until it appears. Hypogeous Basidiomycotina are often more abundant than the Ascomycotina. The key of Trappe and Castellano (1991) enables the collector to differentiate between the two groups.

Ascomata of hypogeous Pezizales are often less fragile than those of epigeous ones. The ascomata may be handled as described above or sturdy ascomata may be placed in waxed paper bags.

2.20 FIELD NOTES. In addition to precise locality, habit, substrate, and habitat data (which may be recorded in the field), information on the morphology of fresh ascomata should be recorded as soon as possible. Macroscopic and microscopic features are best described from fresh material ("vital taxonomy," Baral, 1992). At a minimum, the type of ascoma (see 3.00) and the size, shape, and color of all parts/surfaces should be noted. A sketch showing shape, giving measurements of the various parts, and indicating colors may be useful. The presence and type (color, location, degree of aggregation/dispersal, shape, etc.) of hairs, pustules, or other features that break the smoothness of a surface should be described. A hand lens or stereomicroscope is necessary for examining ornamentation on some ascomata. Colors may be described in common terms, or for greater precision, matched (preferably under a standardized lighting system) with one or more of the standard color references, e.g., Kelly and Judd (1955), Kornerup and Wanscher (1983), Munsell Color Company, Inc. (1976), or Ridgway (1912).

2.30 SPECIMEN PRESERVATION. Once the field notes have been completed, specimens destined for deposit in herbaria are usually preserved by drying for later study. Large specimens and all truffles are cut in half vertically before being dried; the larger truffles may be further cut vertically into slabs ±5 mm thick. Collections may be dried in several ways: 1) on a specially constructed mushroom drier (Smith, 1947); 2) in a home food dehydrator with a heat source and a fan (at relatively low heat to avoid "cooking" the specimens); 3) in a cabinet with a dehumidifier (Trappe, 1982); 4) on activated silica gel if specimens are small or delicate (Hoseney, 1963); or 5) air-dried, when weather permits (suitable only for small ascomata). Mature specimens of epigeous taxa typically discharge their mature ascospores during the drying process; these spores may be deposited on other specimens, the inside of the dryer, or the room containing the dryer (Weber, 1988). Such deposits may interfere with DNA studies of those specimens (K. O'Donnell, pers. comm.). Contamination can be reduced by drying specimens or pieces thereof on silica gel or by lyophilizing tissues. In our experience, lyophilized material is often unsatisfactory for anatomical studies.

3.00. ASCOMATA

3.10. KINDS OF ASCOMATA AND THEIR PARTS. Within the Pezizales, there are many kinds of ascomata (Fig. 1:A-I). The ascoma traditionally associated with the Pezizales is an open epigeous cup (e.g., Fig. 1:B), generally referred to as an apothecium. De Bary (1887) credited P.A. Karsten with introducing the term apothecium in its modern form. De Bary (1887, p. 187) stated, "The distinguishing feature in the apothecium . . . is, that the hymenium lies exposed on the surface of the sporocarp while the spores are forming and maturing"; note the emphasis on the exposed hymenium in this definition. At least three different derivations and/or interpretations of the term apothecium are present in the more recent literature. According to Stearn (1992), a *theca* is a "case" or "cover"; he gives as an example the asci of lichens. As possible translations for *apo-*, Nybakken (1959) includes "lack" or "without" and for *theke*, "sheath," "cover," or "case" (which could refer to asci or to the ascoma). Gäumann (1952) refers to the "ascus hymenium or thecium" and implies that the thecium is exposed (without a cover) in an apothecium. In contrast, Alexopolous et al. (1996) gives the derivation of apothecium from the Greek term *apotheke* meaning "store house." A third approach is exemplified by Hawksworth et al. (1983, p. 22), who define an apothecium as "a cup- or saucer-like ascoma in which the hymenium is exposed at maturity . . . sessile or stipitate." They do not present the derivation of the term; they do accept Trappe's (1979) emendation of the Pezizales, which expands the order to include taxa in which the asci do not forcibly discharge ascospores at maturity and the ascomata are not open epigeous cups (see Gilkey, 1939, Pl. V for an overview of various morphological types of former Tuberales). Hawksworth et al. (1983, p. 286-7) describe the ascomata of each family in the Pezizales in terms of apothecia. We postulate that most members of the former Tuberales are derived from apothecial Pezizales. However, the ascomata of most of the former Tuberales differ enough from the original and current concepts of apothecia that the term should not be applied to them. To highlight some of the major derivative morphologies, we propose an expanded classification of ascomata for the Pezizales with emphasis on the morphology and relationship of the "thecium" (whether it is exposed, enclosed partly or entirely, folded, etc.) in the sense of Gäumann (1952). In general, the same term is used to describe the thecium and the kind of ascoma. Some ascomata, however, e.g., those of *Gyromitra esculenta* (Pers.) Fr., are more complex; in such cases, the kind of thecium must be specified, but other aspects of the morphology of the ascomata must also be considered. Such ascomata could be described as stipitate apothecial ascomata or stipitate apothecia.

3.11. Athecium (pl., athecia, Fig. 1:A). From Greek, literally "without container." "Athecium" is used to describe those situations where no distinct ascoma is formed; only a tuft of asci with or without paraphyses is present, e.g., *Ascodesmis* Tiegh.

3.12. Apothecium (pl. apothecia, Fig. 1:B; Fig. 2:A-J). From Greek, literally "without a case." An apothecium, in the sense of de Bary (1887) consists of an ascoma in which the hymenium is exposed by the time the ascospores are mature; in practice, the definition is usually expanded to include the supporting tissues (primarily the excipulum forming the "receptacle"). No cover or case covers the hymenium at maturity. An apothecium may or may not be stipitate. When a stipe is present, the ascoma is described as a stipitate, apothecial ascoma; the stipe and apothecium are described separately. In all apothecial (as defined here) Pezizales known to us, ascospores are actively expelled from the asci at morphological maturity. The basic form of an apothecium may be concave, plane, or convex [then resembling a pileus, a term usually reserved for certain Basidiomycetes (Hawksworth et al., 1983) but used by Korf (1973) to describe the enlarged portion of stipitate apothecial ascomata such as occur in *Gyromitra* Fr., *Verpa* Swartz, *Morchella* Pers., and some species of *Discina* Fr. and *Helvella* L. (Fig. 2: G-J)]. "Hymenial surface" and "abhymenial surface" denote the back-to-back ascus-bearing and ascus-free surfaces of an apothecium. A stipe may be present or absent. A stipe is considered part of an ascoma rather than part of an apothecium. One benefit of this approach is that in a genus such as *Helvella*, which exhibits great morphological variation, a consistent set of terms is available for the parts of the ascomata. One does not have to wrestle with the question of when an apothecium becomes a pileus and whether or not the stipe is part of the apothecium. Most operculate cup-fungi have apothecia.

Within the Pezizales, the basic epigeous, cup-shaped apothecium has been modified in many ways, leading to the development of several characteristic morphotypes. While some morphotypes show little superficial resemblance to apothecia, others are still recognizable as apothecia in the traditional sense. Two types of very small apothecia, which we refer to as cleistohymenial apothecia and ampulliform apothecia, may be recognized. Brummelen (1967) mentions that certain species of *Ascobolus* (that normally form apothecia in nature) in culture may form ascomata that remain closed throughout their development, releasing their ascospores from the ascomata through decomposition of the walls of the ascomata. Rather than calling such ascomata cleistothecia, a term traditionally applied to the ascomata of the Eurotiales (Ainsworth et al., 1973), we suggest calling them cleistohymenial apothecia in recognition of their basic apothecial structure. Ampulliform apothecia are found in *Octosporella* Döbbeler. Ascomata produced by members of this genus have been interpreted as small perithecia (Döbbeler, 1978); however, on closer examination, Döbbeler (1979) concluded they are actually apothecia with a restricted opening and a hymenium of operculate asci and filiform paraphyses. From the basic apothecium, one can trace sets of modifications to the various morphotypes designated here.

3.13. Cleistothecium (pl. cleistothecia, Fig. 1: G). From Greek, literally "closed container"; the asci are enclosed at maturity in a cleistothecium. Several types of ascomata could qualify as closed containers from minute, thin-walled uniascal ones to larger, fleshy, complex ones. "Cleistothecium" has been applied primarily to closed, small, thin-walled, superficial ascomata that lack differentiated openings and contain one to many asci; the asci arise at different levels or apparently randomly and are liberated through disintegration of the wall of the ascomata. Many cleistothecia have appendages that may become entangled with parts of animals and allow the cleistothecia to "hitchhike" to new localities. The mycelia are likely either saprophytic or parasitic. Such ascomata are characteristic of the Eurotiales, in particular. Closed ascomata have been noted in the Pezizales and former Tuberales, however. If types of ascomata are defined on the basis of a single character, these could be considered cleistothecia. If the definition of "cleistothecium" is based on a suite of co-occurring characters, then calling closed ascomata of *Elaphomyces* and some species of *Ascobolus* Pers. cleistothecia becomes problematical. We suggest that "cleistothecium" be maintained in its traditional sense for small, closed, typically superficial ascomata and that the leathery, closed ascomata produced by species of *Elaphomyces* be called "pulverothecia"
(see 3.16)

3.14. Exothecium (pl. exothecia, Fig. 1:D). From Greek, literally "outside container." An exothecium is an ascoma with a strongly convex hymenium of asci and paraphyses that essentially covers the exterior, leaving no discernible margin (no abhymenial surface can be distinguished). Exothecia are typically relatively small, hypogeous, and produce indehiscent asci that are persistently and distinctly shorter than the paraphyses. In exothecia, the tips of the paraphyses in most taxa are enlarged and/or branched to form a tissue (epithecium) covering the asci and are themselves embedded in or coated with a mucilaginous layer. Examples include *Ruhlandiella* P. Henn. *emend.* Dissing & Korf and *Sphaerosoma* Klotzsch. Exothecia appear to represent everted or extremely convex hymenia where the sterile tissues have been reduced to a minimum. In an emarginate apothecium, the ascospores are forcibly discharged; in an exothecium, they are retained in the asci at morphological maturity.

3.15. Ptychothecium (pl., ptychtothecia, Fig. 1:E, F, G, H). From Greek, literally "folded container." A ptychothecium bears a persistent, recognizable hymenium of asci and, typically, paraphyses arranged in a distinct palisade that is borne within an infolded to chambered or solid ascoma. One or more openings to the surface may be present. An epithecium is present in some taxa; a stipe is absent in most taxa, but in some there is a distinct basal tuft at the point of attachment. Most ptychothecia develop and remain below ground. The asci are generally indehiscent; the best-known exception is *Geopora* Harkn. with dehiscent asci and ascomata that may have a simple chamber or a multitude of labyrinthine chambers apparently formed by infolding. In *Hydnotrya* Berk. & Broome, the ascomata similarly may have simple to multiple chambers, but the asci are indehiscent. In *Choiromyces* Vittad., the hymenia meander through a solid gleba. In contrast to exothecia, in ptychothecia the mature hymenium is typically enclosed to a significant degree within the ascomata, and the ascomata are usually larger and have a higher proportion of sterile tissue relative to hymenial area.

3.16. Pulverothecium (pl. pulverothecia; Fig. 1:C). From Greek, literally "powdery container." Over the years, *Elaphomyces* has been classified in at least four different orders: the Tuberales (Clements and Shear, 1931; Korf, 1973), the Plectascales (Dennis, 1978), the Elaphomycetales (Trappe, 1979), and the Pezizales (Landvik and Eriksson, 1994). Some consideration of their ascomata is therefore appropriate here. Unlike typical cleistothecia, the ascomata of *Elaphomyces* are usually hypogeous, the mycelium is mycorrhizal, the asci develop inside a hollow structure in an apparently unique manner, and the ascospores are dispersed by wind. This happens when small mammals excavate the ascomata, carry them into the tree canopy, and consume the peridium, thereby freeing the powdery spores to be dispersed by the wind. The ascomata of *Elaphomyces* thus differ in many respects from typical cleistothecia; in recognition of these differences they are given a descriptor of their own.

3.17. Stereothecium (pl. stereothecia, Fig. 1:I). From Greek, literally "solid container." A stereothecium is an ascoma with a distinct, more or less continuous peridium enclosing a more or less solid mass of tissue. Within the gleba at the time the ascospores are mature, the asci are indehiscent and appear to be either solitary and scattered relatively evenly throughout the gleba or grouped in dispersed pockets or meandering veins. In very young specimens of some taxa, the immature asci may be aligned in a more or less recognizable hymenium, but this stage is transitory. Openings, if present, through the peridium to the surface are in the form of mycelium-stuffed veins. The classic idea of a truffle in the genus *Tuber* is the standard for the stereothecium. However, stereothecia may have a stipe or stipe/columella as in *Fischerula* Mattir. Stereothecia, pulverothecia, and cleistothecia are closed structures with the asci often scattered in their interior. Individual stereothecia and pulverothecia are typically 0.5 to 10.0 cm in diam; in contrast, individual cleistothecia seldom, if ever, exceed 0.2 cm in diam, and most are best measured in µm. In stereothecia, the gleba is typically fleshy, the asci are persistent, and the parent mycelium is hypogeous and mycorrhizal; stereothecia are adapted to a style of animal mycophagy in which the animals typically consume both the gleba and the peridium. In pulverothecia the gleba is powdery at maturity, the asci disintegrate, and the mycelium is hypogeous and mycorrhizal; pulverothecia are adapted to a style of animal mycophagy in which the animals frequently consume the peridium rather than the powdery gleba. In cleistothecia, the asci may or may not persist, the parent mycelium is typically saprobic or parasitic on dung, plants, animals, or other fungi, and mammalian mycophagy is not important in ascospore dispersal.

3.18. Key to Ascomata of the Pezizales and Elaphomycetales.

1. Distinct ascomata not produced; asci grouped with or without paraphyses on a weft of hyphae (which may or may not be prominent);

ascospores forcibly discharged .... Athecium

1. Distinct ascomata produced, sterile tissue present; ascospores forcibly discharged or retained in the asci at morphological maturity 2
   2. Mature asci typically exposed to the atmosphere in open ascomata or ascomata with differentiated openings to the atmosphere at maturity; ascospores typically forcibly discharged from the asci and escaping in this way from ascomata 3
   2. Mature asci enclosed within a continuous excipulum, peridium, or hymenium with a well-developed epithecium (asci persistently shorter than paraphyses whose apices, at least, form a more or less distinct tissue); ascospores typically released from ascomata through disintegration or digestion of ascomata 4
3. Ascoma typically epigeous or opening in such a manner that most asci are potentially able to release ascospores directly to the atmosphere; hymenium typically covering the surface with maximum exposure to light, e.g., lining a cup or pits or on upper surface of recurved portion .... Apothecium
3. Ascoma typically hypogeous to somewhat emergent; hymenium located on folds of tissue or lining cavities initially enclosed within the wall of the ascoma; only a minor portion of the hymenium, if any, regularly exposed to the atmosphere through rupture of the wall at maturity .... Ptychothecium
   4. Asci arranged in a hymenium on the outer, more or less convex surface of a typically hypogeous ascoma lacking a distinct margin; tips of paraphyses exceeding mature asci, enlarged and/or interwoven and forming an epithecium; hymenium often covered with mucilage; gleba absent .... Exothecium
   4. Asci either not enclosed by a thick epithecium coated with mucilage, or, if an epithecium is present, hymenium at least partly enclosed by the peridium; gleba present 5
5. Asci arranged in a persistent hymenium at maturity .... Ptychothecium
5. Asci scattered to clustered but not arranged in a distinct hymenium at maturity 6
   6. Ascomata minute (a few µm to 0.1–0.2 cm in diam); superficial on dung, plant parts, animals, or other fungi; with or without specialized appendages adapted for dispersal via "hitchhiking" on animals .... Cleistothecium
   6. Ascomata macroscopic (ca 0.5–10 cm in diam), fleshy to tough; typically hypogeous or at the surface of the soil; adapted for dispersal via mycophagy (fleshy to some degree), consistently

lacking specialized appendages devoted to dispersal 7

7. Interior of ascoma fibrous to hollow when young; asci developing among cottony hyphae within a more or less hollow structure, disintegrating by maturity to leave a powdery mass of free ascospores .... Pulverothecium

7. Interior of ascoma fleshy/solid and typically remaining so; asci developing singly or in pockets or veins within the fleshy/solid matrix, persisting beyond morphological maturity of the ascospores .... Stereothecium

3.20. SYMMETRY OF ASCOMATA. The following terms are used to describe the symmetry of ascomata as viewed from above and based on the number of axes of symmetry evident in the ascoma.

3.21. Radial symmetry. An ascoma that, as viewed from above, is essentially circular in outline with all diameters nearly or actually the same length (length:width ratio 6:5 to 6:6, Hawksworth et al., 1983), is **radially symmetric** or **regular** (Fig. 3:A); it exhibits **radial symmetry**.

3.22. Bilateral symmetry. If two orthogonal axes of symmetry exist and the axes are of different lengths (length:width ratios from 6:1 to 6:5) the ascoma is **compressed** (Fig. 3:B); it exhibits **compound bilateral symmetry** (bilaterally symmetric in relation to two axes). If only one axis of symmetry exists, the ascoma is **bilaterally symmetric** (Fig. 3:C); it exhibits **simple bilateral symmetry** (bilaterally symmetric in relation to a single axis).

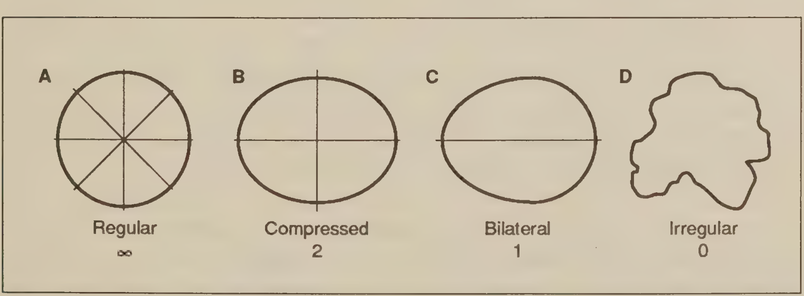

Figure 3. Types of symmetry of ascomata as viewed from above. A, regular, radially symmetric, infinite number of axes; B, compressed, bilaterally symmetric in relation to two axes; C, bilateral, bilaterally symmetric in relation to a single axis; D, irregular, no axis of symmetry.

3.23. Asymmetry. If no axis of symmetry can be discerned, it is **irregular** or **asymmetric** (Fig. 3:D); it exhibits **asymmetry**.

4.00. SURFACE FEATURES OF ASCOMATA

4.10. INTRODUCTION. Stearn (1992) lists a number of characters and character states that may be useful when describing surfaces of Pezizalean ascomata. He implies that characters should be defined with care and that terms should not be forced to perform too many functions, e.g., he recognized the following as separate categories: 1) ways in which a surface may be uneven, 2) the appearance ("polish" or "texture") of a surface, and 3) features of the elements (hairs, squamules, etc.) that extend beyond the surface.

Stearn's (1992) observation that "plants possess more types of hair-covering than there exist special terms to designate them, hence the uncertain and overlapping use of many terms . . ." is equally applicable to the fungi. Much can be observed of the surface features of Pezizalean ascomata by using a handlens or stereomicroscope. However, examination of the components of the ornamentation with a compound microscope is frequently necessary in order to make or confirm identifications.

4.20. FEATURES TO CONSIDER. Rather than proposing a classification of types of ascomatal ornamentation, we have tried to define the major characters and mention representative character states.

4.21. Evenness of sterile surface. Is the sterile surface of the ascoma even or uneven?

4.22. Form of uneven surface. If intrinsically uneven, as distinct from possessing superficial hairs or processes, is it 1) embossed, e.g., the verrucae of the black diamond truffle, *Tuber melanosporum* Vittad.; 2) lacunose, e.g., the stipe of *Helvella lacunosa* Afz.; 3) rugose, e.g., the base of *Sarcosoma mexicanum* (Ellis & Holway) Paden & Tylutki?

4.23. Visual effect of ornamentation. If differentiated cells or aggregations of cells are present and extend beyond the surface of the ascoma, describe its general form, e.g., pustulate, villose, tomentose, pruinose, hispid, squamose, verrucose.

4.24. Distribution of ornamentation. Is ornamentation 1) evenly dispersed over surface, 2) denser toward or at margin, 3) denser toward base or point of attachment?

4.25. Arrangement of the elements of the ornamentation. Are they isolated or clustered?

4.26. Relation to surface. Is ornamentation apparently innate, appressed, erect, ascending, or tangled?

4.27. Color of ornamentation. Describe color as viewed with stereomicroscope or hand lens both in terms of whether it is concolorous with the surface or differently colored.

4.30. MARGIN. We follow Korf (1973) and define the margin as the portion of an apothecium (or ptychothecium with regular openings to the surface) extending from the meristematic region [the "growing-point" of Corner (1929)] where the hymenium and the excipulum diverge to that region on the abhymenial surface where the elements of the excipulum have essentially completed their maturation. The junction between the "margin" and the "flank" of the apothecium is not well marked; in most taxa it is approximately the level equivalent to the base of the hymenium. Two extremes in the probable continuum of types of margin correlate with the cleistohymenial and eugymnohymenial types of hymenial development described by Brummelen (1967). In cleistohymenial apothecia, the margin may be entirely or nearly entirely composed of remnants of a continuous tissue that covered the developing hymenium, e.g., *Selenaspora guernisacii*; in such apothecia, little expansion of the apothecium because of activities of the growing-point is apparent. In contrast, in eugymnohymenial apothecia with an excipulum, the hymenium is exposed from the first; new asci and paraphyses may develop on the proximal side and new excipular tissues on the distal side of the growing-point, allowing for considerable expansion of the apothecium. When describing the features of the margin for field notes, the same features discussed for the abhymenial surface of an ascoma should be covered. Additional characters worth noting include the curvature at different stages of maturation, color (if different from the hymenial and/or abhymenial surfaces), and regularity and pattern of splitting (if any).

SUMMARY

Care and consistency when collecting, handling, processing, and studying collections of the Pezizales is basic to all derivative studies. This begins with attention to detail in the field and when processing specimens for later identification and other studies. Familiarity with the features of the group and the way in which they are described should result in notes useful to all who later study the material.

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PROTODAEDALEA, A SYNONYM OF *ELMERINA* (HETEROBASIDIOMYCETES)

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Abstract

Protodaedalea hispida Imaz., the only species in *Protodaedalea* Imaz. 1955 is shown to be a synonym of *Elmerina holophaea* (Bres.) Parm. (Auriculariales, Heterobasidiomycetes). The genus *Elmerina* is distributed in Pacific Asia and Australia.

The genus *Elmerina* was described by Bresadola (1912) and typified by *Hexagona cladophora* Berk., a favoloid species from the Philippines with a daedaloid-lamellate hymenophore and numerous hyphal pegs. Three years later a second species, *Elmerina foliacea* Pat., was described from the same country (Patouillard 1915). The genus has been related to *Daedalea* Fr. (Bresadola, op. cit.), *Lenzites* Fr. (Patouillard, op. cit.), *Favolus* Fr. (Parmasto 1984), *Hexagonia* Fr., and *Trametes* Fr. (Humphrey 1938, Ryvarden 1993) because of the similar hymenophore configuration. Ryvarden (op. cit.) considered the taxonomic position of *Elmerina* as "uncertain" and suggested relationships with *Tyromyces* based on the mono-to dimitic hyphal system shared by both genera.

Parmasto (1984) illustrated and described fresh basidiocarps of the species from Eastern Russia. He demonstrated that *E. holophaea* (Pat.) Parm. is the earliest legitimate name for the taxon described as *E. foliacea* by Patouillard. Parmasto (op. cit.) also discussed the relationships of *Elmerina* with other genera in the Agaricaceae and Polyporaceae and proposed to include the genus in the latter family.

In 1955, Imazeki described *Protodaedalea* in Heterobasidiomycetes based on *P. hispida* Imaz., a species from Japan with pileate basidiocarps, lamellate hymenophore, hyphal pegs on the tubes, and clavate basidia becoming vertically septate when mature. He initially placed his genus in Tulasnellaceae (Imazeki 1955), but later transferred it to Tremellaceae (Imazeki & Hongo 1965). The genus was accepted by Bandoni et al. (1982) in Tremellales in their treatment of poroid heterobasidiomycetes. They considered the consistency of basidiocarps of *P. hispida* which do not revive when soaked, and the clavate basidia at maturity as relevant taxonomic characters to keep the genus separated from other poroid Heterobasidiomycetes as *Protomerulius* Møller and *Aporpium* Sing. Bandoni (1984) included the three genera in the family Aporpiaceae (Auriculariales) because they share a dimitic hyphal system and a myxarioid type of basidia in comparison with the monomitic Exidiaceae (see below).

Corner (1989) mentioned the close resemblance of sterile *Elmerina* basidiocarps with those of pileate *Aporpium* species. However, it was not until Reid revealed the septate nature of the basidia of *Elmerina* that this genus was correctly placed among the Heterobasidiomycetes (Reid 1992). He merged the genus with *Aporpium*, and combined all poroid species with septate basidia in *Elmerina* 1912, without considering *Protomerulius* Møller from 1895. He did not discuss *Protodaedalea* in his treatment (Reid, op. cit.).

The similarity of *Protodaedalea hispida* with the description and illustrations of *Elmerina holophaea* by Parmasto (op. cit.) made me borrow Patouillard's type specimens from the Philippines. Besides, Parmasto's record of *E. holophaea* from Far Eastern Russia, Vietnam and Philippines was compatible with the possiblility that the species could also occur in Japan.

The types of *E. holophaea* and *E. foliacea* were almost black, horny and lamellate, as described for dry specimens of *Protodaedalea hispida* in the literature (Bandoni et al. 1982, Parmasto 1984). I found basidia in almost all stages of development in the type of *E. foliacea*, from initially aseptate to apically septate (Fig. 1), and basidiospores that matched with those of *Protodaedalea hispida* (10-12(13) x 6-7(8) µm). The type of *E. holophaea* was sterile, but its conspecificity with *E. cladophora*, the other species in the genus, was disregarded as basidiocarps of the latter dry brown to reddish-brown and the pores remain ochraceous with abundant hyphal pegs (Humphrey 1938, Reid, op. cit.).

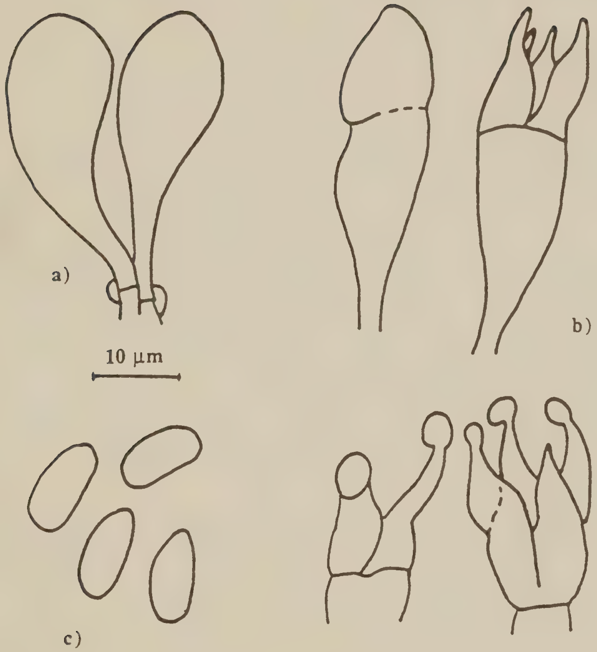

Fig. 1. Basidia and basidiospores of *Elmerina foliacea* Pat. a) probasidia b) epibasidia development c) basidiospores. From the typus (FH).

Differences between *Elmerina* and other poroid Heterobasidiomycetes

I follow here Ryvarden's opinion that *Aporpium* is a later synonym of *Protomerulius* (Ryvarden 1993). For differences between the genera, the reader is referred to Bandoni et al. (1982).

Elmerina and *Protomerulius* have a basically similar basidia development: probasidia are initially aseptate, clavate in *Elmerina* (20-38 x 9-12 µm), obpyriform to almost globose in *Protomerulius* (7-10 x 4.5-6 µm). Further development is of the myxarioid type, i.e. probasidia dividing into two cells, the upper one forming the epibasidia (Bandoni 1984, Reid 1992). While epibasidia in *Protomerulius* appear already septate at very early stages, even before sterigmata start to form (Setliff & Ryvarden 1981, Bandoni et al. 1982, pers. obs.), epibasidia in *Elmerina* remain aseptate until the development of sterigmata. This is probably the reason why *Elmerina* has traditionally been placed in Polyporaceae (Homobasidiomycetes).

A second difference between *Elmerina* and *Protomerulius* besides basidia development is the texture of fresh basidiocarps, watery-cartilaginous in *Elmerina* and leathery to fibrous in *Protomerulius* (Bandoni et al., op. cit.).

When it comes to basidiocarp habit as taxonomic character, Humphrey (1938) observed that *E. cladophora*, usually pileate, "at times forms large resupinate poroid sheets at the point of attachment of the pileus". Reid (1992) suggested that the resupinate *Aporpium borneensis* Jülich and the pileate *A. hexagonioides* David & Jaq. were conspecific with *E. cladophora* despite their different basidiocarp habit, as the three taxa shared the same basidia development, hyphal system and spore size, besides occurring in the same geographical areas. I have compared the type of *A. borneensis* with two herbarium specimens of *E. cladophora* (see below). The colour and texture of basidiocarps are different, and I feel that fresh material should be compared before concluding the conspecificity of the two taxa. Nevertheless, the three taxa share the *Elmerina* type of basidia development explained above.

Similarly, obpyriform to globose, septate epibasidia typical for *Protomerulius* occur on one hand in the pileate *P. africanum* (Ryv.) Ryv., *P. substuppeus* Berk. and *Aporpium dimidiatum* David - the two last taxa are probably conspecific following

David's description of *A. dimidiatum* (David 1974) -, and on the other hand in the resupinate *P. brasiliensis* Møller and *P. caryae* (Schwein) Ryv. (Setliff & Ryvarden 1982, Bandoni et al. 1982). These facts point to the inadequacy of using basidiocarp habit as a taxonomic character to separate between *Elmerina* and *Protomerulius*. Traditionally more relevance is given to basidia ontogeny than to basidiocarp habit in Heterobasidiomycetes taxonomy at genus level (Oberwinkler 1972, Bandoni 1984).

Specimens examined:

A. borneense Jülich, Borneo, Sarawak, Gunong Mulu Nat. Park., camp 2, 500 m.o.s.l., 22.3.1978, nr. 78.2902 (typus, L).

E. cladophora (as *E. foliacea*): Papua New Guinea, Napan g., Waoboe, 2.5.1943, Satake Niimura, 213718, (TNS); 26.3.1943, Satake Niimura 213717 (TNS).

Lentinus holophaeus Pat., Tonkin, vallée du Da Pounian, Eberhardi-LBA 267 (typus, FH), RUSSIA: Regio Primorsk, reservatum Suputinka (lk-ala.), Saare segamutr, E. Parmasto, on *Alnus hirsuta*, 24.9.1961 (TAA 14560), distr. Ussurijsk, reservatum Ussuricum, M. Saar, on *Populus* sp., 3.8.1979 (TAA 118556), distr. Ternei, Maisa, E. Parmasto, on *Betula mandshurica*, 11.9.90 (TAA 150931), 13.9.1990 (TAA 151003), 15.9.1990 (TAA 151130), distr. Chugujevski, Bulyga-Fadejevo, Kljuch Pravaja Sololovka, E. Parmasto, on *Betula* sp., 8.8.1981 (TAA 103844), distr. Hasan, reservatum Kedrovaja Padj, Kljutsch Suchoi, E. Parmasto, on hardwood, 22.7.1985 (TAA 106210); Regio Chabarovsk, Balshe-Chechtshirski, Kljutsh Levyi, E. Parmasto, on hardwood, 1.9.1979 (TAA 102279).

Elmerina foliacea Pat., Mt. Maquiling near Los Baños, Prov. Laguna, Philippines, C. J. Baker, Jan. 31 1914, (typus, FH).

Protodaedalea hispida: Japan: Aomori prefecture, Towada, Wachi, 26.9.1939, Y. Hayashi (TFM), near Towada, Kita-morokata, Aoidake, 3.9.1966, T. Kobayashi (TFM); Hokkaido prefecture, Yamabe exp. forest, 9.1962, K. Aoshima (TFM), Numa-no-sawa, Jubari, 19.9.1990, T. Hattori (TFM 15812), Akan Nat. Park, 22.9.1994, M. Núñez 604 (O); Ibaraki prefecture, Kita-Ibaraki, Osho-yama, Y. Abe et al., 25.9.1989 (TFM 15149, 15150), Ogawa, 28.3.95 M. Núñez 743 (O); Kagoshima prefecture, Kimotsuki, 15.10.1963, K. Aoshima & H. Furukawa (TFM); Miyazaki prefecture, 13.10.1963, K. Aoshima & H. Furukawa (TFM); Tottori prefecture, Daisen,

San-no-sawa, Kansai myc. Ass., 6.8.1990 (TFM15731); Yamanashi prefecture, Mt. Fuji, H. Furukawa & 6.10.1964, T. Kobayashi (TFM), 8.9.67, T. Kobayashi (TFM).
Protomerulius substuppeus : Brazil, Trail 123 (typus, K).

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ASPERGILLUS CAELATUS, A NEW SPECIES IN SECTION *FLAVI*

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ABSTRACT

Aspergillus caelatus, a new species belonging to subgenus *Circumdati* section *Flavi*, is described from agricultural soils and peanut seeds in southwestern Georgia, USA. The species is similar to *A. tamarii*, but differs in colony color and smaller conidiophore structures as well as in its mycotoxin profile.

Species belonging to *Aspergillus* subgenus *Circumdati* section *Flavi* are among the most studied fungi owing to their importance in food fermentations (Cook and Campbell-Platt, 1994) and in the formation of mycotoxins (Kozakiewicz, 1994). The carcinogenic aflatoxins produced by *A. flavus* Link, *A. parasiticus* Speare, and *A. nomius* Kurtzman et al. have been subjects of intensive biochemical and medical research (Eaton and Groopman, 1994). In the peanut-growing regions of southwestern Georgia, an undescribed species of *Aspergillus* in section *Flavi* is frequently isolated from agricultural soils and also occurs in peanut seeds from insect-damaged pods (Horn and Greene, 1995; Horn et al., 1995). This distinctive species was originally designated as *A. tamarii* type B pending its formal description (Horn and Greene, 1995; Horn et al., 1995, 1996) and is herein described.

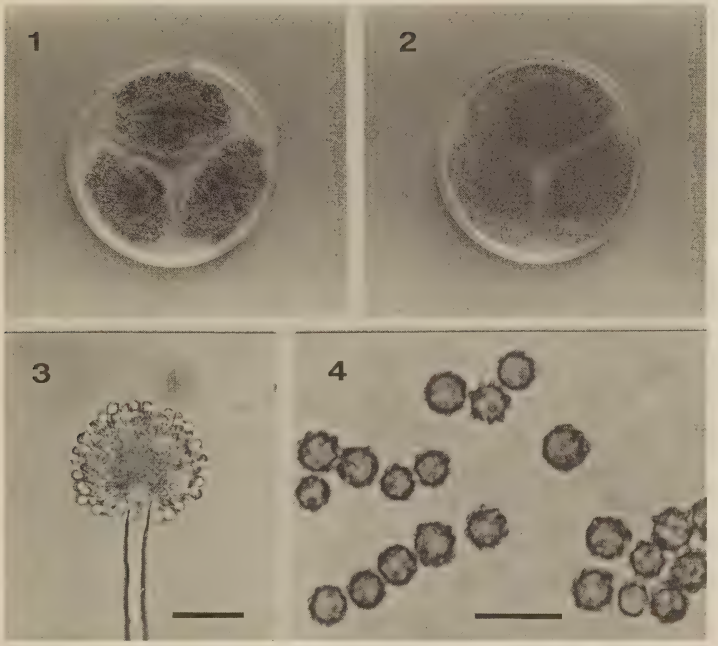
Aspergillus caelatus B. W. Horn, sp. nov. Figs. 1-4

Coloniae in agaro Czapekii ad 25 C post 7 dies usque ad diametrum 3.0-4.5 (-5.5) cm crescunt; ad 37 C post 7 dies ad diametrum 3.5-5.5 cm. Superficies coloniarum in aspectu velveti, ex capitulis conidialibus abundantibus composita (Fig. 1). Capitula conidialia in toto visa olivacea (1-2E5; Kornerup et Wanscher, 1978) post 7 dies (ad 25 C), post 14 dies olivacea brunnescentia et fuscantia (2E4-F4; Kornerup et Wanscher, 1978). Pars aversa flavido-brunnea; agar pigmentum diffluens concolor continens; isolationes sclerotiales exsudatum pellucidum vel subroseo-brunneum continentes. Sclerotia absentia vel abundantia, primo alba, deinde roseo-brunnea, prostremo purpureo-atra, subglobosa vel elongata vel saepe in ambitu irregularia, 400-1700 µm longa, 200-1100 µm lata. Capitula conidialia uni- vel biseriata, radiata, plerumque in columnas laxas divergentes findentia, diametro usque ad 600 µm. Stipes hyalini, subexasperati, longitudine variabili plerumque (100-) 200-800 (-1000) µm, diametro statim sub vesicula (6-) 8-12 (-14) µm. Vesiculae globosae vel subglobosae, diametro (12-) 15-38 µm, in parte distali 3/4 fertiles; metulae 4.5-11.5 x 2.5-6.0 µm; phialides 5.0-11.0 x 3.0-6.0 µm (Fig. 3). Conidia globosa, crassotunicata, grano sporae diametrum (4.5-) 5.0-6.0 (-7.0) µm attingenti; ornamentatio grossa, e tuberculis et transtris brevibus composita, <1.5 µm alta (Fig. 4).

Coloniae in extracto malti post 7 dies ad 25 C diametrum 6.0-8.0 cm attingentes. Superficies coloniae in aspectu velveti (Fig. 2). Capitula conidialia post 14 dies in toto visa olivacea (1-2E5; Kornerup et Wanscher, 1978). Sclerotia absentia vel sparsa.

HOLOTYPUS: cultura exsiccata NRRL 25528, in isolatione e solo agarvi *Arachidis hypogaeae*, Terrell Co., Georgia, USA, 8 die mensis Junii 1992 lecta, in National Fungus Collections, US Department of Agriculture, Beltsville, Maryland (BPI 737601) deposita. Culturae vivae NRRL 25528 in ARS Culture Collection, Peoria, Illinois depositae.

Colonies on Czapek agar attaining a diameter of 3.0-4.5 (-5.5) cm in 7 days at 25 C; growth at 37 C in 7 days reaching a



Figs. 1-4. *Aspergillus caelatus* (NRRL 25528). 1. Colonies on Czapek agar (14 days; 25 C). 2. Colonies on malt extract agar (14 days; 25 C). 3. Biseriate head. Bright-field microscopy; bar = 30 µm. 4. Conidia. Bright-field microscopy; bar = 10 µm.

diameter of 3.5-5.5 cm. Colony surface mostly velvety, consisting of abundant conidial heads (Fig. 1). Conidial heads en masse olive (1-2E5; Kornerup and Wanscher, 1978) at 7 days (25 C), shifting to a darker, browner olive (2E4-F4; Kornerup and Wanscher, 1978) by 14 days. Reverse pale yellow brown; agar medium with diffusable pigment of the same color; clear to light pink-brown exudate present in sclerotial isolates. **Sclerotia** absent to abundant, white becoming pink brown and finally purple black, subglobose to elongate and often irregular in shape, 400-1700 µm long and 200-1100 µm wide.

Conidial heads uniseriate or biseriate, radiate, usually splitting into loose divergent columns, up to 600 µm in diameter. **Stipes** hyaline, finely roughened; length variable, mostly (100-) 200-800 (-1000) µm; diameter immediately below vesicle (6-) 8-12 (-14) µm. **Vesicles** globose or subglobose, (12-) 15-38 µm in diameter, fertile over upper three-fourths; **metulae** 4.5-11.5 x 2.5-6.0 µm; **phialides** 5.0-11.0 x 3.0-6.0 µm (Fig. 3). **Conidia** globose and thick walled, with spore body (4.5-) 5.0-6.0 (-7.0) µm in diameter; ornamentation coarse, consisting of tubercles and short bars <1.5 µm high (Fig. 4).

Colonies on malt extract agar attaining a diameter of 6.0-8.0 cm in 7 days at 25 C. Colony surface velvety (Fig. 2). Conidial heads en masse olive (1-2E5; Kornerup and Wanscher, 1978) at 14 days. Sclerotia absent or sparse.

HOLOTYPE: dried plate culture of NRRL 25528, isolated from soil collected 8 June 1992 in a peanut field, Terrell Co., Georgia, USA, has been deposited with the National Fungus Collections, US Department of Agriculture, Beltsville, Maryland (BPI 737601). Living cultures of NRRL 25528 have been deposited in the ARS Culture Collection, Peoria, Illinois.

The specific epithet, which is from Latin meaning chiseled or carved, refers to the roughened ornamentation of the conidia. The description of *A. caelatus* is based on three isolates each from vegetative compatibility groups 1-3 which were obtained from soil in a peanut field in southwestern Georgia (Horn and Greene, 1995). NRRL 25528, ex holotype of *A. caelatus*, belongs to vegetative compatibility group 1 and produces numerous sclerotia. For this study, *A. caelatus* was compared to isolates of *A. tamarii* Kita from Horn and Greene (1995) (three isolates each from vegetative compatibility groups 1-3) as well as NRRL 20818 (= CBS 104.13), ex lectotype of *A. tamarii*, and NRRL 429 (= WB 429), used for the description of *A. tamarii* by Raper and Fennell (1965).

The olive, radiate conidial heads and the predominantly globose vesicles that are fertile over most of their surface, combined with the presence of metulae and the roughened hyaline stipes, place *A.*

caelatus in section *Flavi* (formerly the *A. flavus* group) of the subgenus *Circumdati* (Christensen, 1981; Gams et al., 1985; Raper and Fennell, 1965). Within the section, *A. caelatus* most closely resembles *A. tamarii*. Both species have thick-walled, coarsely roughened conidia that are similar in size (Christensen, 1981; Horn and Greene, 1995; Raper and Fennell, 1965). However, vesicle diameter (27 ± 4.9 µm) (± SD), stipe width (10 ± 1.7 µm), and stipe length (520 ± 206.3 µm) of biseriate heads of *A. caelatus* are significantly smaller ($P < 0.001$; $n = 36$) than those of *A. tamarii* (42 ± 6.7, 15 ± 1.4, and 1220 ± 251.7 µm, respectively) (Horn and Greene, 1995).

Colony color on Czapek agar is the easiest means of distinguishing *A. caelatus* from *A. tamarii*. In *A. caelatus*, conidial heads en masse at 14 days were olive (2E4-F4) (Kornerup and Wanscher, 1978) and in *A. tamarii*, heads ranged from olive brown (4E6-F6) in isolates from Horn and Greene (1995) to between olive brown (4E6-F6) and yellowish brown (5E6-F6) in NRRL 20818 and 429. Digital color image processing of colonies and filtered conidia of *A. caelatus* and *A. tamarii*, as well as *A. flavus* and *A. parasiticus*, also shows significant differences in the intensity of the primary colors red, green, and blue (Horn et al., 1996). In addition, *A. caelatus* typically produces a yellow-brown diffusable pigment in the medium; isolates of *A. tamarii* recovered by Horn and Greene (1995) lack this pigmentation. The small conidiophores of *A. caelatus* give colonies a close-textured appearance suggestive of *A. parasiticus* whereas colonies of *A. tamarii*, characteristically with larger conidiophores, are much coarser (Christensen, 1981; Horn and Greene, 1995; Raper and Fennell, 1965). Horn et al. (1996) also reported that 22 of the 32 *A. caelatus* isolates examined produced sclerotia; none of the 34 *A. tamarii* isolates obtained in the same study was sclerotial. *Aspergillus tamarii* has been reported to produce sclerotia (Raper and Fennell, 1965), though it is possible that some of those isolates represented *A. caelatus*.

Aspergillus caelatus and *A. tamarii* also differ in nonmorphological characters. In the study of soil populations of *Aspergillus* species from section *Flavi*, all isolates of *A. caelatus* were vegetatively incompatible with those of *A. tamarii* (Horn and Greene, 1995). Furthermore, Horn et al. (1996) showed that isolates of *A. caelatus* (n = 25) produced kojic acid (116.3-226.8 μg/ml medium) but no detectable cyclopiazonic acid whereas *A. tamarii* isolates (n = 32) formed kojic acid at lower levels (5.9-70.3 μg/ml) and consistently produced cyclopiazonic acid (5.5-41.9 μg/ml). None of the *A. caelatus* and *A. tamarii* isolates examined produced aflatoxins.

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NOTES ON ACAULOSPORA BIRETICULATA (GLOMALES, ZYGOMYCETES) FOUND IN POLAND

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Abstract

Morphological features of spores of *Acaulospora bireticulata* Rothwell & Trappe are described and illustrated. The fungus described in this paper was isolated from the root zone of *Ammophila arenaria* Link and *Artemisia campestris* L. colonizing maritime sand dune soils adjacent to the Baltic Sea, Poland. *Acaulospora bireticulata* forms light orange to yellowish brown spores with seven walls arranged in three groups. The muronym of the spore wall structure of this fungal species is A(ELo) B(UU) C(MbCM). The innermost wall of group C stains pale red in Melzer's reagent.

Key Words: Glomales, *Acaulospora bireticulata*, occurrence, Poland

Introduction

Acaulospora bireticulata Rothwell & Trappe was originally described as forming hyaline to light brown spores with a wall consisting of three layers (Rothwell & Trappe 1979). The most distinctive feature of this fungus is the ornamentation of the structural spore wall. According to Rothwell and Trappe (1979), the ornamentation is composed of a polygonal reticulum developed on the spore surface beset with round–tipped, 4– to 6–sided processes, ±1µm.

Schenck and Pérez (1990) assigned the spore wall structure of *A. bireticulata* a muronym of A(UoMM).

In 1985 and 1986, the author of this paper found three walls in *A. bireticulata* spores (Błaszkowski 1989). However, only a few specimens were investigated.

Investigations of the occurrence of arbuscular mycorrhizal fungi associated with roots of plants colonizing maritime sand dune soils adjacent to Świnoujście, Poland revealed a number of *A. bireticulata* spores with seven walls. The aim of this paper is to describe and illustrate these spores as well as to present the distribution of this fungus in the world.

Materials and methods

Roots and attached soil of sample plants were collected from a depth of 5–30 cm and refrigerated at 4 C for 2–6 months. Trap cultures were established by mixing field–collected soils and roots with autoclaved coarse–grained sand (1:2, v/v; pH 6.6, 13 and 12 mgL^{-1} P and K, respectively). This mixture was placed in 15–cm plastic pots (1350 cm^3) and seeded with *Sorghum sudanense* (Staph.) Piper. Additionally, single–species pot cultures were established by placing 50–80 field–collected spores on roots of 7–14–day–old *S. sudanense* seedlings. The seedlings were subsequently grown in 150–cm^3 pots containing an autoclaved soil:sand mixture prepared as described above. Plants were grown in a greenhouse at 18–30 C with 12 h photoperiod (combined incandescent and cool white fluorescent light) and watered 2–3 times a week. Pot cultures were harvested after six to eight months, roots stained (Phillips & Hayman 1970) and examined for the presence of mycorrhizae.

To extract spores, both field-collected soils and those from pot cultures were wet sieved and decanted (Gerdemann & Nicolson 1963). No newly formed spores were found in either trap or single-species cultures. Therefore, only field-collected spores were further investigated. At least 100 and 20 spores were mounted in polyvinyl alcohol/lactic acid/glycerol, PVLG (Koske & Tessier 1983) and Melzer's reagent, respectively, and examined. Wall descriptions and terminology follow those suggested by Walker (1983, 1986) and Walker, Reed & Sanders (1984). Spore color was examined under a dissecting microscope on fresh specimens immersed in water. Color names are from Kornerup and Wanscher (1983). Specimens of *Acaulospora bireticulata* have been preserved on slides mounted in PVLG and deposited in the Department of Plant Pathology (DPP), Academy of Agriculture, Szczecin, Poland (see "COLLECTIONS EXAMINED"). Nomenclature of fungi is according to Walker and Trappe (1993). Classification is that of Morton and Benny (1990).

Description and discussion

Acaulospora bireticulata Rothwell & Trappe

Figs. 1–7.

Sporocarps unknown. *Spores* formed singly in the soil; laterally on the neck of a sporiferous saccule; sessile; light orange (5A5) to yellowish brown (5E8); globose to subglobose; (150–) 190 (–210) µm in diam; sometimes irregular, 130–180 x 170–250 µm; a small scar, 7.6–10.0 µm diam, surrounding a pore, 1.0–1.2 µm diam present at the site of spore attachment to the saccule.

Spore wall structure (Fig. 1) of seven walls (1–7) in three groups (A, B, C).

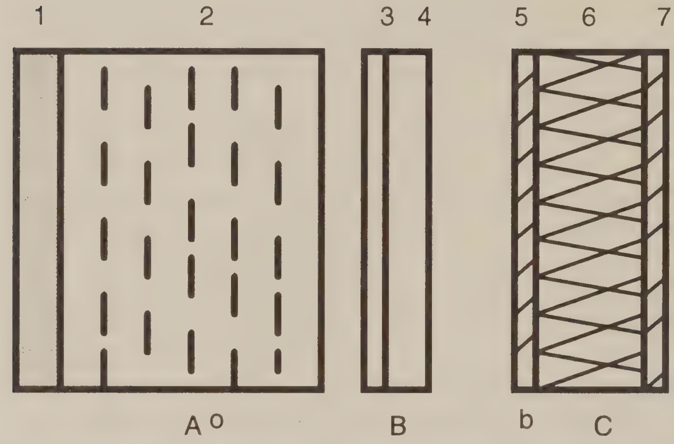
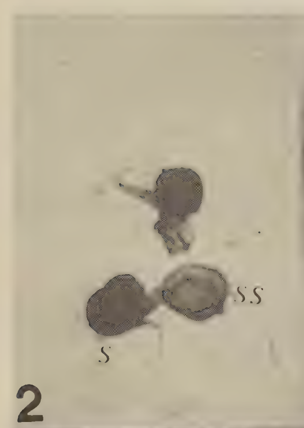


Fig. 1. Murograph of the wall structure of *Acaulospora bireticulata* (after Walker 1983, 1986). Evanescent wall is shaded with dots, laminated wall with broken lines, semi–rigid walls with no lines or dots, membranous walls with diagonal lines, coriaceous wall with cross lines; o=ornamented wall, b=beaded wall. Arabic numerals indicate each wall in order from outer to inner wall; letters indicate wall groups.

Figs. 2–7. *Acaulospora bireticulata.* Numbers indicate spore wall arrangement (see Fig. 1). **2.** Two intact spores (S) with sporiferous saccule (SS), bright–field microscopy (BFM), x53. **3.** The reticulum and spines can be seen (BFM), x421. **4.** Walls 3 and 4 of group B and 5–7 of group C; walls 3 and 4 are tightly adherent in this specimen, differential interference contrast (DIC), x1111. **5.** Outer and inner walls are visible; wall 3 is separated from wall 4 (DIC), x 833. **6.** The beaded membranous wall 5 is separated from the coriaceous wall 6 (DIC), x1111. **7.** The thick coriaceous wall 6 and the thin membranous wall 7 can be seen (DIC), x1111.



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Wall group A consisting of two walls (1, 2). Wall 1 a saccule wall, light yellow (4A4) to apricot yellow (5B6), (0.7–) 1.1 (–2.0) μm thick, closely attached to wall 2. Wall 2 laminated, ornamented, light orange (5A5) to yellowish brown (5E8), (6.8–) 7.1 (–7.4) μm thick; ornamentation consisting of hyaline to yellowish white (3A2) spines, (0.7–) 1.0 (–1.7) μm high and of ridges forming a quadrilateral to heptagonal reticulum when seen in plan view; ridges hyaline to yellowish white (3A2), (2.2–) 3.7 (–4.4) μm high, (1.0–) 1.6 (–2.5) μm wide at the base, (1.2–) 2.7 (–4.4) μm wide at the top, (1.2–) 3.9 (–6.6) μm long when seen in cross view.

Group B of two smooth, hyaline, tightly adherent semi rigid walls (3, 4). Wall 3 (0.4–) 0.5 (–0.7) μm thick. Wall 4 (1.0–) 1.4 (–1.5) μ m thick.

Group C composed of three hyaline walls (5, 6, 7). Wall 5 a beaded membranous wall, ca 0.5 μm thick. Wall 6 coriaceous, (2.7–) 3.6 (–4.9) μm thick. Wall 7 membranous, (0.6–) 0.9 (–1.0) μm thick, tightly adherent to wall 6, staining pale red (7A3) in Melzer's reagent. Spore contents of hyaline oil droplets.

Sporiferous saccule light yellow (4A4) to apricot yellow (5B6); globose to subglobose; 200–250 μm diam; neck 120–200 μm long, tapering from 45–50 μm diam at the saccule to 20–30 μm diam at the point of spore attachment. Saccule wall of a light yellow (4A4) to apricot yellow (5B6), smooth, 1.7–2.8 μm thick layer. Saccule collapsing at maturity and usually becoming detached in mature spores.

COLLECTION EXAMINED. POLAND, Świnoujście, under *Ammophila arenaria* Link, 13 May 1993, *Błaszkowski, J.* 1971–1982 (DPP); under *Artemisia campestris* L., 6 Oct. 1993, *Błaszkowski, J.* 1983–2003 (DPP); under *A. campestris*, 6 Oct. 1993, Błaszkowski, J. unnumbered collections (DPP).

DISTRIBUTION AND HABITAT. In Poland spores of *A. bireticulata* have earlier been found twice: in the root zone of *Triticum aestivum* L. in 1985 and among roots of an unknown grass in 1986 (Błaszkowski 1989). This emended description of the fungus is based on spores recovered from under *Ammophila arenaria* and *Artemisia campestris* colonizing maritime sand dune soils adjacent to Świnoujście. The spore density (Table 1) of *A. bireticulata* ranged from 1 to 66 (av. 18.5) in 100 g dry soil and was highest in the root zone of *A. arenaria* (66), followed by an unknown grass (5), *A. campestris* (2), and *Triticum aestivum* (1). The proportions (Table 1) of spores of this species in the spore populations of all arbuscular fungi recovered ranged from 0.1 to 100% (av. 36.3%). The density of all arbuscular mycorrhizal fungal species ranged from 1 to 9 (av. 5.0) in 100 g dry soil (Table 1). Most arbuscular mycorrhizal fungal species were found in soils collected under an unknown grass (9), then among roots of *T. aestivum* (8), *A. arenaria* (2), and *A. campestris* (1). The fungi occurring together with *A. bireticulata* were *A. thomii* Błaszk., *Glomus caledonium* (Nicol. & Gerd.) Trappe & Gerd., *G. constrictum* Trappe, *G. fasciculatum* (Thaxter) Gerd. & Trappe emend. Walker & Koske, *G. macrocarpum* Tul. & Tul., *G. microcarpum* Tul. & Tul., *G. occultum* Walker, and an undescribed *Glomus* sp. (Table 1).

The chemical properties of two of the four soil samples in which *A. bireticulata* occurred are presented in Table 1. Soil pH was higher at Bolesławiec with *Triticum aestivum.* Concentrations of NO_3, P, and K were also markedly higher at Bolesławiec than at the Kampinos National Park with an unknown grass.

In addition to the Polish collections, there are only three reports of the occurrence of *A. bireticulata* in the literature. Rothwell and Trappe (1979) originally recovered spores of this species from a perimeter soil sample collected under *Sassafrans albidum* (Nutt.) Ness growing in western Kentucky and from a greenhouse culture with *Zea mays* L. Schenck and Smith (1982) found *A. bireticulata* spores in association with *Centrosema pubescens* L. in Florida. Miller *et al.* (1985) isolated this fungus from the root zone of *Malus domestica* Borkh. in Michigan. Recently, Walker (*pers. comm.*) recorded this species in sand dunes in the United Kingdom.

Table 1

Density[a] and proportional abundance[b] of *Acaulospora bireticulata* spores in spore populations of arbuscular fungi isolated, arbuscular taxa associated with this species, and soil chemical properties

Locality	Density	Proportional abundance (%)	Arbuscular taxa	Chemical properties			
				pH	NO^3	P	K
					mgL^{-1}		
Bolesławiec	1	0.1	ATHM, LCLD, LCST, LFSC, LMCC, LMRC, LOCT, L100, CDPP	6.8	29	18	10
Kampinos National Park	5	1.7	APLN, EIFQ, LAGR, LCST, LDMK, LFSC, LMRC, CPLC	5.1	10	14	9
Świnoujście	2	100	No species associated	–[d]	–	–	–
	66	43.4	LCST, L100	–	–	–	–

[a] No. of spores in 100 g dry soil.

[b] (no. of spores of a species/total Glomales spores) x 100.

[c] Arbuscular fungal species represented by code words after Pérez and Schenck (1990).

[d] No data.

MYCORRHIZAL ASSOCIATIONS. *Acaulospora bireticulata* was associated in the field with vesicular–arbuscular mycorrhizae of *Ammophila arenaria, Artemisia campestris, Triticum aestivum,* and an unknown grass. Attempts to establish this species in both trap and single species–isolate pot cultures with *S. sudanense* failed.

The wall structure of *A. bireticulata* spores distinguishes this fungus from all other described species of this genus. The outermost wall 1 is continuous with the wall of the sporiferous saccule neck. It is present in almost all spores investigated and seems to be somewhat more rigid than a typical evanescent wall. The light orange to yellowish brown spore color is formed by pigment concentrated in a relatively thin outer layer of the laminated wall 2. The other laminae of this wall are hyaline. The laminae of wall 2 are very thin and tightly adherent to each other. Therefore, this wall may be mistakenly considered a unit wall. Examination of crushed spores under a microscope equipped with Nomarski differential interference contrast optics easily reveals the presence of laminae in this wall. Walls 3 and 4 are always tightly adherent and are somewhat more rigid than a typical membranous wall. Vigorous crushing of spores usually separates walls 2 and 3. Wall 3 is always thinner than wall 4. Wall 5 is a beaded membranous wall. Wall 6 is thick, but flexible. Thus, this has characteristic features of a coriaceous wall. Wall 7 tightly adheres to wall 6 and does not become plastic in PVLG. This wall separates from wall 6 when spores are forcibly crushed. The recognition of wall 7 is significantly facilitated by its staining reaction in Melzer's reagent.

When observed under a dissecting microscope, spores of *A. bireticulata* may resemble those of *A. cavernata* Błaszk., *A. denticulata* Sieverding & Toro, *A. excavata* Ingley & Walker, *A. foveata* Trappe & Janos, *A. gerdemanii* Schenck & Nicol., *A. rehmii* Sieverding & Toro, *A. scrobiculata* Trappe, *A. spinosa* Walker & Trappe, and *A. tuberculata* Janos & Trappe due to their roughened surface and similarities in shape, color, and dimensions (Błaszkowski 1989; Ingleby *et al.* 1994; Schenck & Pérez 1990). Examination of crushed spores under a light microscope readily distinguishes *A. bireticulata* from all the species listed above having a structural wall ornamented with polygonal segments (*A. denticulata*), pits (*A. excavata, A. foveata, A. cavernata, A. scrobiculata*), an alveolate reticulum (*A. gerdemanii*), labyrinthiform folds (*A. rehmii*), crowded blunt spines (*A. spinosa*), and tubercles (*A. tuberculata*). Additionally, none of these fungi have the spore wall structure of *A. bireticulata*. *Acaulospora appendicula* Spain, Sieverding & Schenck also forms ornamented spores, but Morton *et al.* (1993) suggested it to be a synonym of *A. gerdemanii*. *Acaulospora elegans* Trappe & Gerd. is described as possessing spores ornamented with spines and an alveolate reticulum. According to Morton *et al.* (1993) and Walker (*pers. comm.*), *A. elegans* and *A. bireticulata* represent the same taxon. However, no formal synonymization of *A. bireticulata* with *A. elegans* was so far made.

A unique feature of *A. bireticulata* also is the composition of the innermost wall group C expressed by a muronym of C(MbCM). In species producing spores with a beaded membranous wall in the innermost wall group, this wall is adherent to an amorphous wall, a membranous wall, or a unit wall (Schenck & Pérez 1990). Only *A. appendicula, A. cavernata,* and *A. sporocarpia* Berch form spores with a coriaceous wall (Błaszkowski 1989; Morton 1988, 1989). However, this wall in *A. appendicula* and *A. sporocarpia* is the innermost one. In *A. cavernata* the coriaceous wall is associated with an amorphous wall (*vs.* with a membranous wall in *A. bireticulata*).

Acknowledgment

I would like to thank Professor J. M. Trappe, Oregon State University, Department of Forest Science, USA for his helpful review of the manuscript and Dr. C. Walker, U. K. Forestry Commission for checking the determination of some specimens of *Acaulospora bireticulata* and for informing me of the occurrence of this fungus in the United Kingdom. This research was financially supported in part by The Committee of Scientific Researches, grant no. 6 P205 043 05.

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MYCOTAXON

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DESIGNATION OF EPITYPES FOR LACCARIA PROXIMA AND LACCARIA TORTILIS (AGARICALES)

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ABSTRACT

Epitypes for *Laccaria proxima* (Boud.) Pat. and *L. tortilis* (Bolt.) Cooke are designated to stabilize the concept of these names. These specimens were designated as representative specimens in the recent monograph of the North American taxa of the genus by Mueller, but lacked any legal standing and were presented only to indicate the author's concept of the taxa. These representative specimens are here given formal status as epitypes. The lectotypes of these names are illustrations that lack sufficient micromorphological detail to stabilize the application of the name. The 1994 edition of the ICBN (Tokyo Code) introduces the concept of epitypes for such situations.

INTRODUCTION

Article 9.7 of the 1994 edition of the International Code of Botanical Nomenclature (Tokyo Code) (Greuter et al., 1994) allows researchers to designate a specimen or illustration to clarify the nomenclatural application of a name in cases where the existing type material is demonstrably ambiguous. Such specimens are called epitypes. This is a rule change that should benefit mycology greatly. Many fungal names are represented by type specimens that either are very poorly preserved or are lacking important features of the sporocarp. Many other historical names are typified only by an illustration, and the micro-morphological features necessary for interpreting the name often are not illustrated. Formal designation of an epitype to supplement the holo- or lectotypic material can stabilize the application of such names (Hall and Hindle, 1995).

The genus *Laccaria* Berk. & Br. (Agaricales, Tricholomataceae) is characterized by basidiospores with discrete, conical echinulae composed of microfibrils that run nearly parallel to the axis of the spine (Mueller, 1992; Mueller and Ammirati, 1993; Mueller et al., 1993). While it is relatively easy to recognize a member of the genus when seen in the field, infrageneric identification and classification is difficult in many instances. Species circumscription is based primarily on micromorphological characters plus the color of the basidiocarp. Basidiospore size, shape, and degree of ornamentation plus the number of basidiospores borne per basidia are key infrageneric characters (Mueller, 1992).

Mueller (1987) designated neotypes for *Laccaria proxima* (Boud.) Pat. and *L. tortilis* (Bolt.) Cooke to stabilize the application of these widely used names. The subsequent edition of the International Code of Botanical Nomenclature (Greuter et al., 1988: Art. 7.5), however, stipulated that in the absence of a specimen, illustrations included in the protologue must be chosen as a lectotype if no specimen suitable for lectotypification is available. Accordingly, Mueller (1991) designated the illustrations included in the protologues of *Laccaria proxima* (Boudier, 1881) and *L. tortilis* (Bolton, 1788) as lectotypes even though the circumscription of these names could not be adequately defined without information on micromorphological characters. The superfluous neotypes were designated as "representative specimens" to represent my concepts of these names and to supply the micromorphological characters of the taxon to which these names apply (Mueller, 1991). These representative specimens are elevated to epitypes in this paper.

Laccaria proxima (Boudier) Patouillard, Hymeno. Eur.: 97. 1887.

Basionym: *Clitocybe proxima* Boudier, Bull. Soc. Bot. France 28: 91-92. 1881. Figure 69c.

Type: Plate II, fig.2 in Boudier, Bull. Soc. Bot. France vol. 28. 1881 (lectotype designated by Mueller, 1991). Epitype (*nov.*): France: Montemorency, November 1904, *Boudier s.n.* (as *C. proxima*) (PC!, "neotype" designated by Mueller, 1987; "representative specimen" designated by Mueller, 1991, 1992).

There have been several conflicting published concepts of this name based on different authors' interpretation of Boudier's (1881) illustration and brief description (Mueller and Sundberg, 1981). Although this specimen was collected 23 years after the original publication date, this is the only Boudier specimen labelled *C. proxima* that could be found at PC (Mueller, 1987). Basidiospore data from this specimen closely fit those provided in the original description ("*spores ovales, finement echinulees*"), and its macromorphology is congruent with the description and illustration provided in the protologue.

Laccaria tortilis (Bolton) Cooke, Grevillea 12: 70. 1884.

Basionym: *Agaricus tortilis* Bolton, Hist. fung. Halifax vol 1. p. 41, Tab. XLI, fig. A. 1788. Figure 72b.

Type: Tab. XLI, fig. A. in Bolton, Hist. fung. Halifax vol 1. 1788 (lectotype designated by Mueller, 1991). Epitype (*nov.*): Scotland: Yorkshire, Tanfield Lodge, 6 September 1969, *Orton 3642* (E!, "neotype" designated by Mueller, 1987; "representative specimen" designated by Mueller, 1991, 1992).

Bolton's (1788) illustration clearly illustrates the macromophological traits of this taxon as currently defined. His illustration, however, did not provide any details on micromorphological features. This has resulted in at least two concepts of the name being used in the literature (Mueller, 1987). The specimen here designated as epitype fits the concept used by the majority of modern workers based on common usage. Although not collected from the type locality (no historical material was located and new material could not be obtained from the area due to the disruption of the original habitat), the specimen was obtained from an area similar to Bolton's original site (R. Watling, Edinburgh, personal communication; Mueller, 1987).

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MYCOLOGICAL NOTES, II. NEOTYPIFICATION OF *HEBELOMA CISTOPHILUM*, A MEDITERRANEAN PLEUROCYSTIDIATE SPECIES, AND COMBINATION OF *HEBELOMA CREMEOPALLIDUM* (ESTEVE-RAV. & HEYKOOP) COMB. NOV.[1]

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SUMMARY.- An emended description of *Hebeloma cistophilum*, a species which after revision of a large number of specimens turned out to be pleurocystidiate, is provided; besides, a neotype is proposed. *Hebeloma cremeopallidum*, formerly considered as a variety of *H. vaccinum*, is given specific status and the formal combination is proposed.

INTRODUCTION

In this brief note we continue to publish some of the results of our studies on the genus *Hebeloma* in Spain (cf. ESTEVE-RAVENTÓS & HEYKOOP, 1990; HEYKOOP & al., 1992; ESTEVE-RAVENTÓS, 1995).

During the identification of *Hebeloma* material collected in *Cistus* brushwoods from Central Spain, we observed the presence of pleurocystidia in a taxon which in all other features fitted the traditional concept of *H. cistophilum*. Since *H. cistophilum* is known to be (according to literature) a species lacking pleurocystidia we systematically checked all material of this taxon available at AH and other herbaria. Material coming from several Spanish regions (provinces of Madrid, Guadalajara, Cáceres) and from France was checked, all having differentiated lageniform pleurocystidia, though frequently very scattered and difficult to observe. At the moment, the taxonomic importance of these pleurocystidia in *Hebeloma* remains unclear, as they are normally assumed to be absent in the genus. In this communication a neotype is selected for *Hebeloma cistophilum*, as apparently neither original material nor illustrations do exist.

Furthermore, we propose the new combination of *Hebeloma cremeopallidum*, a species first described as a variety of *H. vaccinum* Romagn. (ESTEVE-RAVENTÓS & HEYKOOP, 1990).

RESULTS

Hebeloma cistophilum Maire, *Bull. Soc. mycol. France* 44: 46. 1928. (Figs. 1-6)

Basidiomata stipitate, densely gregarious, solitary to fasciculate. Pileus campanulate-convex to campanulate-applanate, 2-5.5 cm diam., slightly hygrophanous and striate at margin, reddish-brownish to brown in centre, paler towards the margin. Cuticle glabrous and slightly viscid, with small radial fibrils, difficult to observe. Margin involute, whitish when young, paler than the rest of pileus but finally concolorous. Gills more or less sinuate, adnate, beige-brown, with whitish edge. Lamellulae present. Stipe

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[1] This paper was presented at the XII Congress of European Mycologists, celebrated at Wageningen (The Netherlands) from 3 to 7 september 1995.

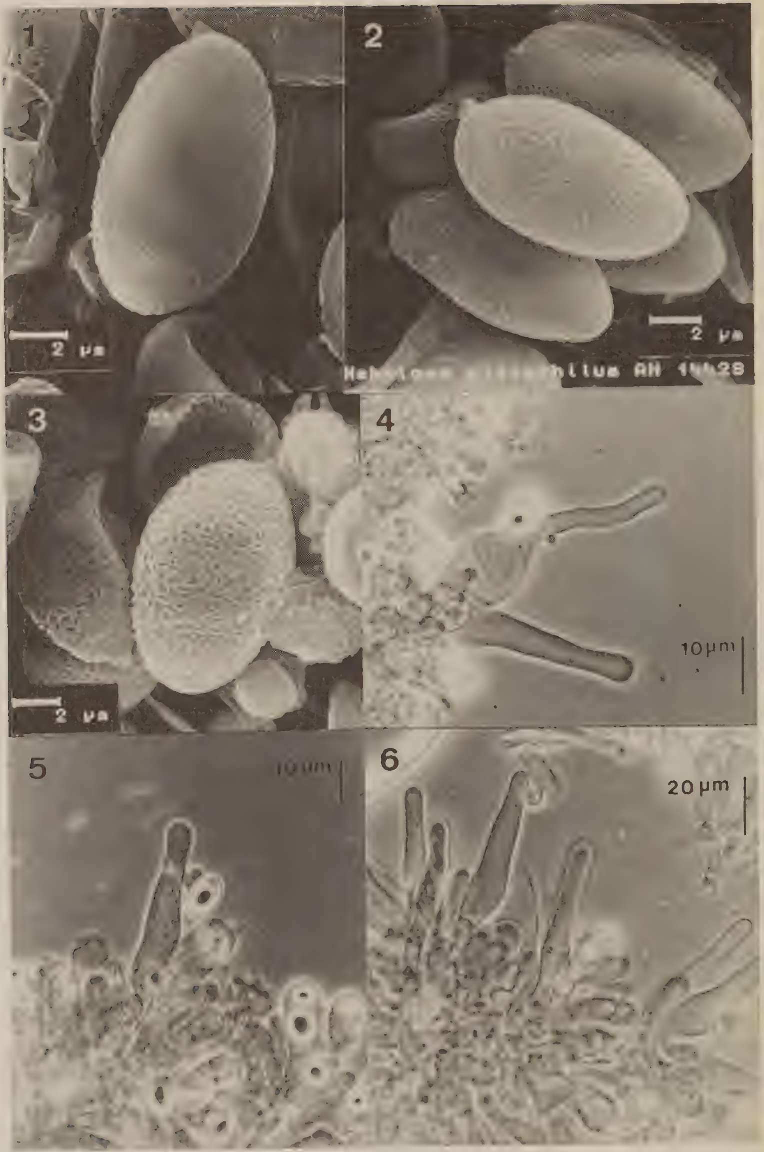
1
2 µm
2
2 µm
Hebeloma cistophilum AH 14428
3
2 µm
4
10 µm
5
10 µm
6
20 µm

Fig. 1: *Hebeloma cistophilum*. Spore under S.E.M. AH 14426. Fig. 2: spores under S.E.M. AH 14428. Fig. 3: spores under S.E.M. AH 14429. Fig. 4: pleurocystidia. AH 14429. Fig. 5: pleurocystidium. AH 18506. Fig. 6: cheilocystidia. AH 18506

cylindrical, 2-5 x 0.5-1 cm, white, with rests of cortiniform veil in young specimens, but fugacious and scarce when old, the upper part covered with caulocystidia (under lens). The lower part turning slightly brownish in old specimens. Flesh of stipe pale beige in the upper part, sometimes darker, darker brown in the lower half. Smell and taste of radish.

Spores brown, 9.5-12 x (5.5) 6-8 µm, ellipsoid to subamygdaliform, some of them ovoid, with obtuse apex which is never papillate nor acute, nearly smooth under optical microscope, but clearly ornamented under SEM. Basidia 4-spored (e.g. 30 x 8 µm). Cheilocystidia 45-64 x (6) 8-13 µm, very abundant, completely covering the lamella edge which is sterile, hyaline, variable in shape but the majority lageniform with more or less flexuous neck ending in an obtuse apex (4-6 µm diam.), sometimes subcapitate, frequently septate. Pleurocystidia present but scarce and sometimes very difficult to find, with a shape similar to that of cheilocystidia though less ventricose, (37) 40-60 (70) x 5.5-7 (12) µm. Pileipellis with suprapellis and subpellis well-differentiated, the former an ixocutis formed by cylindrical hyphae up to 6 µm diam., with encrusting pigment, the latter more or less cellular, pseudoparenchymatic. Clamp connections present.

Material examined: SPAIN: Solana de Cabañas (province of Cáceres), under *Cistus ladanifer*, 14-X-93, leg. F. Esteve-Raventós & M. Heykoop, AH 16748 and 16749. Majaelrayo (province of Guadalajara), under *Cistus laurifolius*, 26-XI-89, leg. P. Cantero, F. Esteve-Raventós & M. Heykoop, AH 12732, 12733 and 12742. Codes (province of Guadalajara), under *Cistus laurifolius*, 18-X-90, leg. J. Alvarez & M. Heykoop, AH 14690. Tamajón (province of Guadalajara), under *Cistus ladanifer*, 25-X-90, leg. G. Moreno & M. Heykoop, AH 14428 and 14689. Tamajón (province of Guadalajara), under *Cistus ladanifer* in an open zone in pine grove of *Pinus nigra ssp. salzmannii* and *P. pinaster*, 25-X-90, leg G. Moreno & M. Heykoop, AH 14673 and 14674. Ciruelos del Pinar (province of Guadalajara), under *Cistus laurifolius*, 29-IX-91, leg. M. Heykoop, AH 14429 (Neotypus). Barbatona (province of Guadalajara), under *Cistus laurifolius*, 21-X-92, leg. M. Heykoop, AH 18506. Cadalso de los Vidrios (province of Madrid), under *Cistus ladanifer*, 3-XII-78, leg. G. Moreno & J.L. Manjón, AH 1448. Between Miraflores and Canencia (province of Madrid), under *Cistus laurifolius*, 30-XI-83, leg. G. Moreno & F. Esteve-Raventós, AH 3569. El Escorial (province of Madrid), under *Cistus ladanifer*, 8-I-76, leg. J. Gómez, C. Gómez, J.A. Barbera & G. Moreno, AH 538. Somontes, El Pardo (province of Madrid), under *Cistus ladanifer*, 8-X-75, leg. G. Moreno, AH 536.
FRANCE: Pezennes, under evergreen oak on siliceous soil, Nov. 1984, leg. Chevassut, Herb. M. Bon N°3661. Porquerolles, under *Cistus sp.*, 4-XI-77, leg. Beller, Herb. M. Bon N° 771104. Le Veillon (Vendée), under *Cistus salvifolius*, 10-XI-89, leg. M. Bon, Herb. M. Bon n° 89218.
NORTH AFRICA: specimen of MPU without number; Herbier Malençon sub *Hebeloma cistophilum* n°1.

DISCUSSION: *Hebeloma cistophilum* is a Mediterranean taxon strictly associated with *Cistus* species. It belongs [together with *H. mesophaeum* (Pers.) Quél.], to section *Indusiatae* (Fr.) Sacc., which is characterized by the presence of hymenial veil (cortina) and the absence of calyptrate spores. It differs from *H. mesophaeum* (Pers.: Fr.) Quél. by its scarce and fugacious veil, uniform brown pileus in old specimens, larger spores and different ecology. *H. hiemale* Bresad. is another species associated with *Cistus* (though not exclusively), but differs from *H. cistophilum* by the lack of veil, brown-yellowish pileus in centre with whitish margin, and its slightly longer spores with different shape. *H. album* Peck s. Bruchet is also associated with *Cistus*, but it lacks any veil, has a bitter taste, capitate cystidia and a whitish pileus.

Hebeloma cistophilum has been frequently collected in Mediterranean countries (MAIRE, 1928; KÜHNER & ROMAGNESI, 1956; MALENÇON & BERTAULT, 1970; BRUCHET, 1970; ORTEGA, 1980; MOSER, 1983; MORENO & al., 1986;

ESTEVE-RAVENTÓS, 1987; BON & CHEVASSUT, 1988; BON, 1992; etc.), but the presence of pleurocystidia has never been mentioned. However, after having examined a large number of collections from different areas we have found pleurocystidia in all of them. These pleurocystidia are similar in shape to cheilocystidia, varying from lageniform to cylindrical-flexuous, although they are commonly very inconspicuous and sometimes difficult to find.

According to SINGER (1986: 607), species in the genus *Hebeloma* lack pleurocystidia. Therefore, it is not surprising that this character has not been mentioned in the literature, as its presence is not checked systematically during microscopical studies. Nevertheless, the presence of pleurocystidia in some species of this section has been pointed by some authors, such as HESLER (1977), SMITH & al. (1983); the latter indicate that these may be cheilocystidia continuing over the edge of the lamellae. We do not agree with this point of view, since in all the material examined we have always removed the upper half of the gill to completely avoid the presence of cheilocystidia. Besides, VESTERHOLT (1989) points that Gröger also has seen such cystidia in *Hebeloma* species. Another pleurocystidiate *Hebeloma* is *H. mackinawense* Hesler & Smith, which differs from *H. cistophilum* because of its larger fruitbodies and differently shaped spores (VESTERHOLT, pers. comm.).

On the other hand, MAIRE (1928) in his original diagnosis of *Hebeloma cistophilum* indicates literally: "*...lamellarum acies pilis cylindraceis flexuosis heteromorpha...cystidia nulla...*". This has led us to try to study the type of this species, but unfortunately Maire neither mentioned any type nor material studied in his original diagnosis nor did he add any illustrations. Therefore, we contacted the herbarium of the University of Montpellier (MPU) where the private herbarium of Maire is supposed to be kept. No original material of *Hebeloma cistophilum* was available at MPU, but there is an exsiccatum labeled with this name and collected by Malençon in North Africa. This material has been studied by us, but owing to its bad condition and the lack of any annotations it has been useless for our purpose.

We have studied numerous collections of this taxon and found pleurocystidia in all of them. Therefore, we believe *Hebeloma cistophilum* to be a pleurocystidiate species, and since there isn't any type available we have decided to neotypify this taxon according to art. 9.9 (GREUTER & al., 1994). As MAIRE & al. (1933) reported this species from the Mediterranean region in Spain, we have selected a Spanish collection, AH 14429, as *Neotypus*.

Hebeloma cremeopallidum (Esteve-Rav. & Heykoop) Esteve-Rav. & Heykoop, comb. nov.
≡ *Hebeloma vaccinum* Romagn. var. *cremeopallidum* Esteve-Rav. & Heykoop, *Cryptogamie Mycol.* 11(1): 24 (1990).

We originally hesitated to treat this taxon on specific level, considering the patent differences between *H. vaccinum* and *H. cremeopallidum*, based mainly on pileus colour and spores with a different shape and size (ESTEVE-RAVENTÓS & HEYKOOP, 1990). In both taxa the perisporium is easily detached, and they have similar cheilocystidia and habitat. VESTERHOLT (pers. comm.), after revision of the type (AH 9392), agrees with the new treatment.

ACKNOWLEDGEMENTS

We thank Dr. Jan Vesterholt (Denmark) for reviewing the manuscript of this paper and for his valuable suggestions.

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MYCOTAXON

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VIBRISSEA PFISTERI, A NEW SPECIES WITH AN UNUSUAL ECOLOGY

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ABSTRACT

A new species, *Vibrissea pfisteri*, growing on a dry stump, is described and illustrated from the United States. Placement in one of the three sections of *Vibrissea* proved difficult, and redefinitions of *V.* sect. *Apostemium* and *V.* sect. *Microstemium* are provided.

INTRODUCTION

Vibrissea is generally considered an aero-aquatic genus of discomycetes, since apothecia are typically found growing on substrates immersed in water, or at least on substrates that are splashed by water or are water-soaked. A new species, *V. pfisteri*, described here, was found by Donald H. Pfister in a forest that had been dry during the entire summer of 1995, with no water source, stream, brook, or spring in the area. The woods are at sea level, and relative humidity is high (Pfister, personal communication). Such an ecological niche is completely new for the genus.

Vibrissea was arranged in four sections by Sánchez and Korf (1966), emphasizing differences in apothecial color, in presence or absence of a stipe, in paraphysis apices, and in ascus and ascospore sizes (Iturriaga, 1995). One of these sections, *Vibrissea* sect. *Leucovibrissea* Sánchez, has been removed from the genus and elevated to generic rank (Korf, 1991).

MATERIALS AND METHODS

Dried and rehydrated apothecia were studied with both a dissecting microscope and an Olympus compound microscope equipped with phase contrast and a drawing tube. Squash mounts of apothecia were made and observed under water, Melzer's reagent, Poirrier's blue in lactic acid, and aqueous KOH-phloxine-glycerine. Apothecia were also sectioned at 20 µm with a freezing microtome. Sections were floated into water and then transfered to clean slides with the mountants listed above. Photographs of apothecia were taken under a Leica Wild M3C stereomicroscope equipped with a rotary stage.

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DESCRIPTION

Vibrissea pfisteri Iturriaga & Korf, sp. nov. Figs. 1-6.

Apothecia pulvinata, confluentia, grisea, 0.25-0.5 mm diam, ascosporis ad superficiem himenii saepe adhaerentibus, itaque simultudinem capillorum habentibus; asci clavati, longi, J+, (83.9-) 104.5-140.3 (-154.6) X (9.3-) 11.2-14.9 µm, octospori; paraphyses filiformes, simplices vel divisae, ad medium 1.5 µm latae, versus apicem 1.5-2.3 µm latum interdum dilatatae; ascosporae filiformes, aseptatae vel 3-7-septatae, (61.5-) 65.3-80.7 (-84.6) X 2.3-3.1 µm, corpora refractiva (guttulas olei) includentes. Ad lignum. Holotypus: CUP-63569.

Apothecia pulvinate, greyish throughout, 0.25-0.5 mm diameter, gregarious, on drying out losing their pulvinate shape and individual apothecia confluent, merging together as a whitish-grey mycelial mat with randomly located thickened pads. At maturity the filiform ascospores are ejected from the asci, and often remain attached to the surface of the hymenium by their extremities, looking like hairs attached to the disc.

Ectal excipulum brownish, of textura porrecta, cells turning outwards at an acute angle relative to the surface of the receptacle, cells 10.0-16.2 x 2.3-4.6 µm, cell wall up to 1 µm thick. Perihymenial zone not blued by iodine.

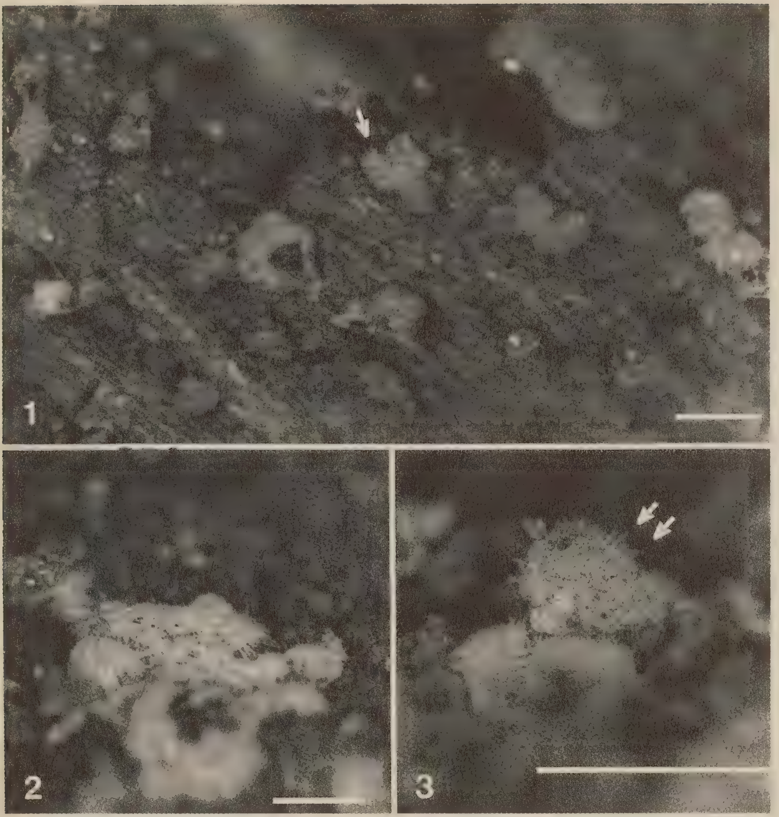
Subhymenium and medullary excipulum not distinguishable.

Base of the apothecium brown, forming a round, sclerotium-like pad of textura epidermoidea mixed with long cells, all cells thick-walled, 7.7-16.2 X 2.3-6.2 µm.

Asci clavate, long, (83.9-) 104.5-140.3 (-154.6) X (9.3-) 11.2-14.9 µm, with a strongly papillate apex, prominent when immature, but still very evident when mature, rarely not present, pore J^+, 8-spored.

Paraphyses filiform, simple or divided, 1.5 µm wide at the middle, sometimes slightly enlarged to 1.5-2.3 µm wide at the apex.

Ascospores filiform, hyaline, aseptate to 3-7-septate, basal end tapering and apical end rounded, (61.5-) 65.3-80.7 (-84.6) X 2.3-3.1 µm, with refractive inclusions (oil drops) present in water and in all



Figs. 1-3. *Vibrissea pfisteri* (type). **1.** Several pulvinate apothecia on wood of dry stump. Ascospores attached to the hymenium can be seen (arrow). **2.** Confluent apothecia in an irregular mass. **3.** Pulvinate apothecia in which ascospores attached to the hymenium can be seen (arrows). Bars = 1 mm.

mountants used, inclusions cyanophobic in cotton blue, and also not staining in cresyl blue; sometimes germinating inside the ascus.

Culture: Colony 35 mm diameter after 4-1⁄2 months on PDA, beige to cream-yellowish, with dark-brown stromatic concentric rings. A living culture (D. H. Pfister # 191, ex type) has been deposited in ATCC, and MUCL.

Holotype: On tree stump. Oven's Mouth Preserve. Boothbay, Lincoln County, Maine, U. S. A., 9 October 1995. Leg. D. H. Pfister. CUP-63569; isotype, FH.

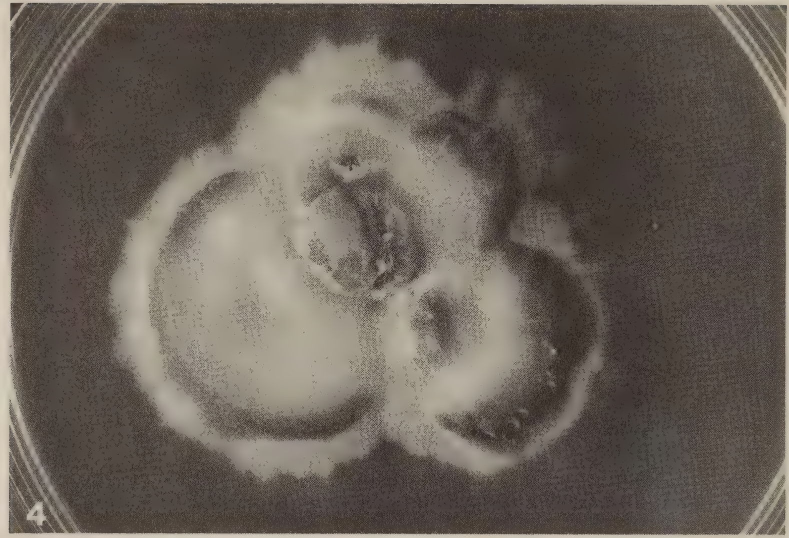


Fig. 4. 4-½ month old culture of *Vibrissea pfisteri* on PDA (cultured from type), X2.

DISCUSSION

The three sections remaining in *Vibrissea* after recognition of *Leucovibrissea* (A. Sánchez) Korf at generic rank are the strongly stipitate *Vibrissea* sect. *Vibrissea*, always on woody substrata, and the two other sections with much smaller apothecia. The species in *Vibrissea* sect. *Apostemium* (P. Karst.) A. Sánchez & Korf are sessile to short-stipitate with otherwise similar characters to those of the type section. In *Vibrissea* sect. *Microstemium* A. Sánchez, the apothecia tend to be much smaller, on herbaceous substrata (grasses, sedges, *Equisetum*), and to have markedly broader asci and shorter and broader ascospores.

Beaton and Weste (1980) gave a revised key to incorporate the Australasian species they described, but did not indicate in which section their new species *V. leucocephala* Beaton & Weste (which ocurs on petioles of *Schefflera rigida* (Bl.) Harms) belongs. Based on their description, except for ascospore length, which is shorter than typical for *V.* sect. *Apostemium*, *V. leucocephala* could be accomodated there.

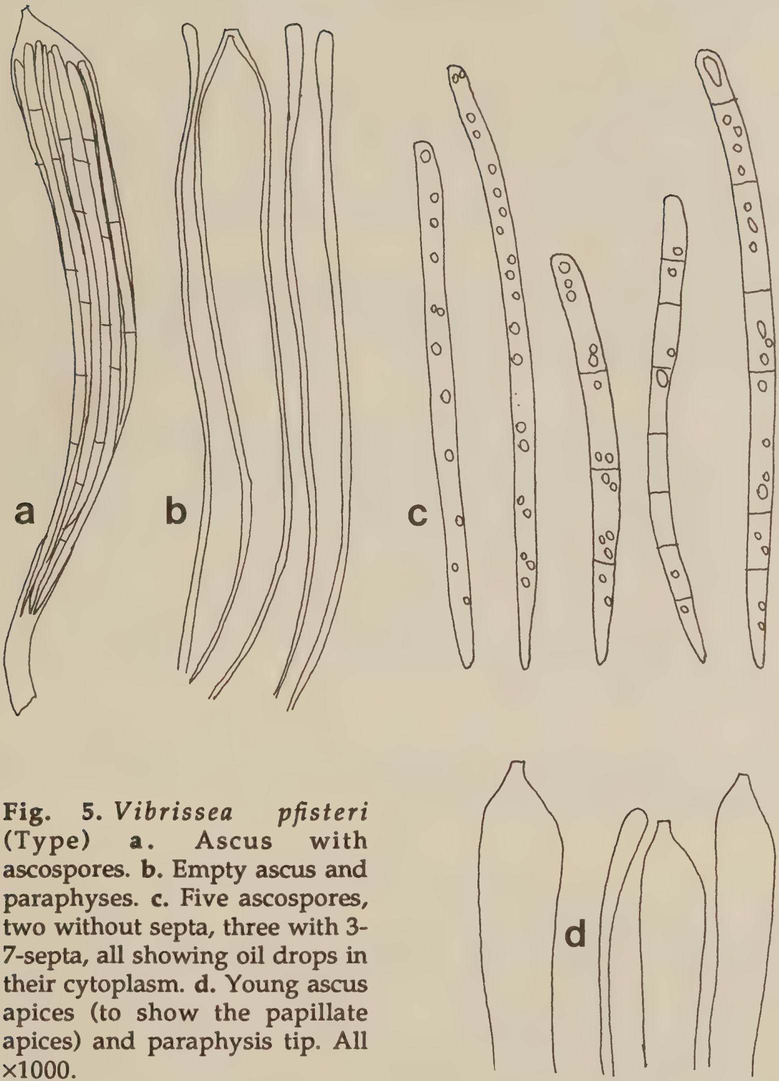


Fig. 5. *Vibrissea pfisteri* (Type) **a.** Ascus with ascospores. **b.** Empty ascus and paraphyses. **c.** Five ascospores, two without septa, three with 3-7-septa, all showing oil drops in their cytoplasm. **d.** Young ascus apices (to show the papillate apices) and paraphysis tip. All ×1000.

Iturriaga (1995) also had difficulty in assigning *V. strossmayerioides* Korf & Iturriaga to a section, but opted for its inclusion in *V.* sect. *Apostemium* despite the ascospores being much shorter (35-60 µm), than defined by Sánchez & Korf (1966) for that section (100-470 µm).

V. pfisteri differs from all species previously placed in *V.* sect. *Apostemium* in having much smaller apothecia with much shorter ascospores than other species (with the exception of *V. strossmayerioides* Korf & Iturriaga), and of course in its ecology. It differs from *V. strossmayerioides* in having pulvinate apothecia, wider asci, longer ascospores in one bundle, and paraphyses apices slightly enlarged.

Once again, with *V. pfisteri*, I find the original definitions of the sections to be too strict. On ascus characters and apothecial size, the species seem to fit *V.* sect. *Microstemium*, but ascospore length is smaller than allowed there, and the occurrence on a woody substrate also speaks against that placement.

I have concluded that a redefinition of the two sections is imperative. The type section, *V.* sect. *Vibrissea*, offers thus far no problems. But for the other two sections, clearly ascospores length and width, and ascus width, must be removed as distinguishing characters. All that remains is the substrate difference, wood vs. herbaceous material. There is a general tendency for the apothecia of *V.* sect. *Microstemium* on herbaceous materials to be minute, and to have generally short, relatively wide ascospores in wider asci. Much greater variability occurs in apothecial size, and ascus and ascospore characters in *V.* sect. *Apostemium*, with apothecia always on wood.

I thus assign *Vibrissea pfisteri* to *V.* sect. *Apostemium*, and though I continue to recognize *V.* sect. *Microstemium*, its status as distict now lies primarily on its substrate specificity.

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Leica Wild M3C stereomicroscope, I thank James Aist, Plant Pathology Department, Cornell University. The photograph of the culture, and enlargement and prints of apothecial photographs were made by Kent Loeffler, Plant Pathology Department, Cornell University, whose help is gratefully acknowledged.

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MYCOTAXON

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A PRELIMINARY DISCOMYCETE FLORA OF MACARONESIA: PART 10a, DERMATEACEAE[1]

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> "Nature is the art of God."
> Sir Thomas Browne
> RELIGIO MEDICI, Part I, Sect. XVI

Order HELOTIALES
Suborder DERMATEINEAE
Family DERMATEACEAE Fr. 1849

KEY TO THE KNOWN MACARONESIAN GENERA

1. Ectal excipulum dark brown; apothecia arising from a distinct stroma, on living herbaceous plant parts (Subfamily **Pseudopezizoideae**) 2

1´. Ectal excipulum hyaline or pale brown 3

  2(1). Excipulum nearly or completely lacking at the sides though well developed below; apothecium arising from a pseudostroma; ascus pore J– **Pseudopeziza**

  2´(1). Excipulum well developed at the sides; apothecium arising from a pseudostroma or after overwintering on a true stroma; ascus pore J+ or J– **Leptotrochila**

3(1´). Parasitic or saprobic, on wood; apothecia erumpent, margin not surrounded by torn excipular tissue; asci usually large, ascus pore J+ after 2–10% KOH pretreatment;

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[1] The parts of this flora will appear in irregular order. Offprints of this part may be requested from the Plant Pathology Herbarium at Cornell University. For special features of this flora, see *Mycotaxon* **13:** 144. 1981.

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ascospores hyaline, frequently 1–3 (–6) septate to muriform at maturity ..... **Pezicula** (Subfamily **Peziculoideae**)

3´(1´). Saprobic, on leaves; apothecia circular or rarely elongated, immersed below the epidermis which sheds as a disk to expose the hymenium, sessile; asci small, ascus pore usually J–; ascospores hyaline, eventually sometimes brownish, unicellular
Trochila (Subfamily **Naevioideae**)

PEZICULA Tul. & C. Tul. 1865

KEY TO THE KNOWN MACARONESIAN SPECIES

1. Asci very broad clavate to saccate (with very short stipe), up to 28 μm wide; apothecia up to 0.5 mm diam; on stems of *Rubus* .... **5. P. rubi**

1´. Asci clavate or cylindric-clavate, up to 25 μm wide; apothecia 0.5-1 mm diam; not on stems of *Rubus* 2

2(1´). Apothecia not erumpent; receptacle and disc cream-white; paraphysis apices propoloid-anastomosing, forming an epithecium .... **4. P. linda**

2´(1´). Apothecia erumpent; receptacle and disc not cream-white; paraphysis apices not propoloid 3

3(2´). Apothecia discoid, disc cinnamon-brown becoming dark reddish brown in patches; asci 13-20 μm wide
1. P. cinnamomea

3´(2´). Apothecia turbinate, disc bright yellow, yellowish-beige, or yellowish-brown; asci 16-26 μm wide 4

4(3´). Ascospores 6-10 μm wide; paraphysis apices swollen and deformed, glued together, forming an epithecium; on seed pods of *Eucalyptus*
2. P. eucalypti

4´(3´). Ascospores 7-14 μm wide; paraphysis apices swollen, branching, forming an epithecium; on branches of *Prunus* .... **3. P. houghtonii**

1. **Pezicula cinnamomea** (DC. : Fr.) Sacc., Michelia **2**: 332. 1881.

RECENT TAXONOMIC TREATMENTS:
Dennis (1974), Dennis (1978), Kehr (1992).

PREVIOUS MACARONESIAN RECORDS:
None.

TYPE LOCALITY:
Jura Mountains, France.

KNOWN MACARONESIAN DISTRIBUTION

MADEIRA
Madeira. CUP-MM 1494.

SUBSTRATUM:
On decorticated wood.

Notes: We measured the asci as (63-) 80-99 (-103) x 13-21 µm, shorter than reported by Dennis (1974), 100-125 x 15-19 µm. Our ascospores measured (16-) 23-41 x (7-) 8-9 (-14) µm, compared to Dennis (1974), 16–28 (-30) x 6-9 µm, and Saccardo (1881) 20-25 x 8–9 µm, agreeing better with Wollenweber (1939), 18–34 x 6–10 µm. Paraphyses when viewed in Melzer's Reagent have irregular wall markings at the apex. A dematiaceous hyphomycete is present in this collection (*Triposporium* sp.).

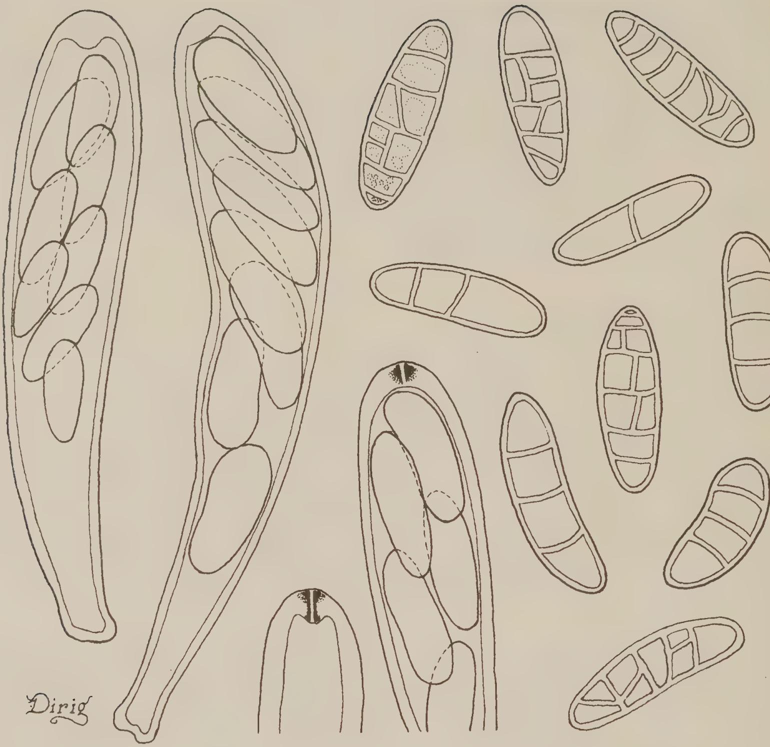
As Kehr (1992) points out, there has been and is still confusion and disagreement between authors regarding species delimitation in the genus *Pezicula*. Dennis (1974) and Kehr (1992) agree in suggesting that until further evidence is presented, it is convenient to accept *Pezicula cinnamomea* as a species with a broad host range.

2. **Pezicula eucalypti** Korf & Iturriaga, **sp. nov.**

RECENT TAXONOMIC TREATMENTS:
None.

PREVIOUS MACARONESIAN RECORDS:
None.

Apothecia turbinata, solitaria, erumpentia, statu vegeto flavescentia, sessilia vel subsessilia. Receptaculum brunneum vel bruneolum. Discus pruinosus, laete flavus, <0.85 mm diam et convexus ubi rehydratus. Excipuli ectalis stratum exterius ex textura angulari, stratum interius ex textura porrecta formatum. Excipulum medullare ex textura globulosa formatum. Subhymenium non distinguibile. Asci 8–spori, clavati, J+ in solutione reactiva Melzeri post usum solutionis 10% KOH, (84-) 93-110 (-125) x (16-) 19-22 (-24) µm. Ascosporae biseriatae vel irregulariter biseriatae, longi–ellipsoideae et saepe in latere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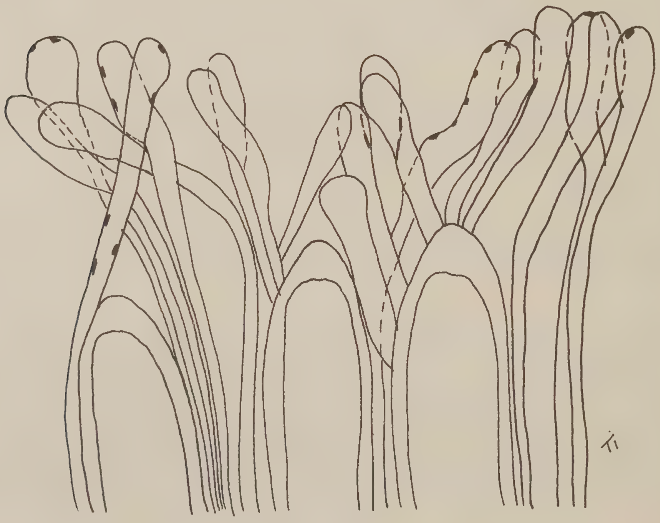
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uno complanatae, aseptatae, guttulam unam polarem vel guttulas duas varie sitas continentes, hyalinae, 18-28 (-30) x (6.6-) 7.3-9.5 µm. Paraphyses apice valde tumidae et deformes, ascos excedentes, apicibus conglutinatis et epithecium ex materia amorpha resinosa ut videtur sic formantibus.

APOTHECIA turbinate, solitary, erumpent, yellowish when fresh, sessile to subsessile. RECEPTACLE light brown to brownish-beige. DISC pruinose, still bright-yellow two years after drying, beige after 20 years, <0.85 mm diam and convex when rehydrated, 0.2-0.4 mm diam when dry. ECTAL EXCIPULUM outer layer of textura angularis, thinner at margin and thicker at flanks, 28-65 µm thick, cells at margin more or less elongated with a rounded apex, cells at flanks more or less isodiametric, 7–15 µm diam, walls refractive; inner layer of ectal excipulum of textura porrecta, inconspicuous at the margin where 12–16 µm wide, thickening towards the flank where 19–23 µm wide, and at the base 62-115 µm wide. MEDULLARY EXCIPULUM of textura globulosa, with irregularly-globose to ellipsoid-cells mixed with textura porrecta, cell walls somewhat refractive, cells 16-26 x 12–15 µm. SUBHYMENIUM not distinguishable. HYMENIUM 130 µm thick. ASCI 8-spored, clavate, J+ in Melzer's Reagent after 10% KOH pretreatment, (84-) 93-110 (-125) x (16-) 19-22 (-24) µm, protruding above the hymenium in iodine mounts. ASCOSPORES irregularly biseriate to biseriate, long-ellipsoid and frequently flattened on one side, aseptate, with one polar guttule or two variously placed guttules, hyaline, 18–28 (-29) x (6.6-) 7.3–9.5 µm. PARAPHYSES strongly swollen and deformed at apex, exceeding the asci, apices glued together forming an epithecium which appears to be composed of an amorphous, resinous material.

HOLOTYPE: Canary Islands, Tenerife, on seed pods of *Eucalyptus* sp., 4 km east of Bailaderos, Punta de Anaga, leg. R. P. Korf, R. Fogel, G. L. Hennebert, & L. M. Kohn, 31. xii. 1976, CUP-MM 1305.

KNOWN MACARONESIAN DISTRIBUTION

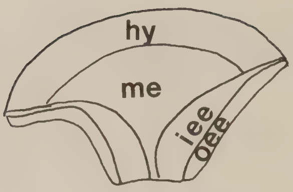
CANARY ISLANDS
Tenerife. CUP-MM 1305.

P. cinnamomea, young ascus, mature ascus; ascus apices showing the iodine reaction; transversely septate and muriform mature spores; detail of hymenium showing asci and paraphyses (with wall markings) forming an epithecium, all CUP-MM 1494, x1000.

SUBSTRATUM:
On seed pods of *Eucalyptus* sp.

Notes: This differs from *P. crataegi* (Lasch) Fuckel in that the receptacle of *P. eucalypti* is yellowish, while in *P. crataegi* it is olive to dark-red-brown. It differs from *P. rubi* (Lib.) Niessl in shape and non-septation of ascospores and the presence of an epithecial resin.

Pezicula species are usually very host specific (Johansen, 1949).



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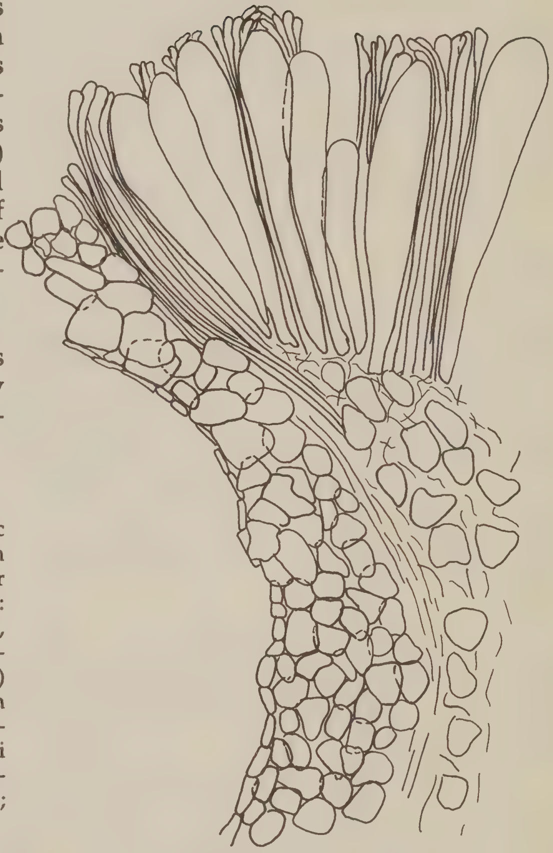
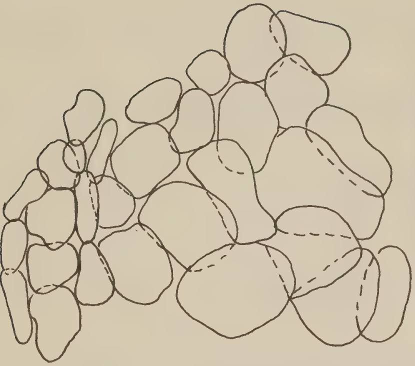
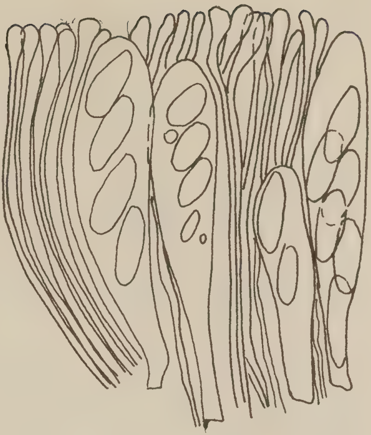
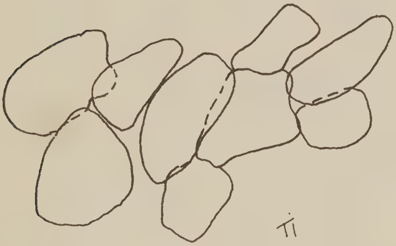


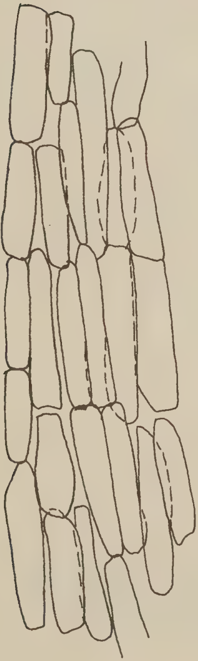
P. eucalypti, schematic median section of an apothecium, (oee: outer ectal excipulum, iee: inner ectal excipulum, me: medullary excipulum, hy: hymenium) x50; detail of median section of an apothecium showing asci and paraphyses forming an epithecium, x500; all CUP-MM 1305.

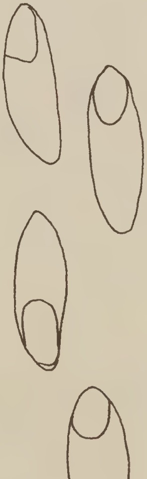
P. eucalypti, detail of outer ectal excipulum at flanks, outer surface to left; detail of hymenium with asci, ascospores, paraphyses, and epithecium, x500; cells of inner ectal excipulum; outer ectal excipulum at margin; 4 immature ascospores showing oil drops; young ascus with immature ascospores; 3 mature ascospores; ascus apex, showing a broad blue pore in Melzer's Reagent after 10% KOH pretreatment; all CUP-MM 1305, all except upper right figure at x1000.

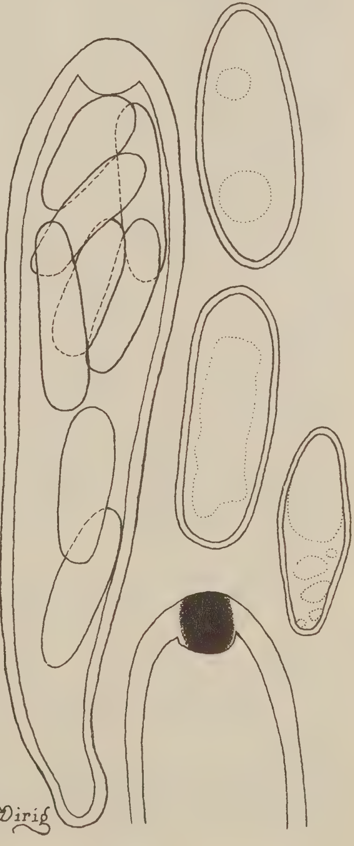












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3. **Pezicula houghtonii** (W. Phillips) Groves, Mycologia 38: 417. 1946.

≡ *Dermatea houghtonii* W. Phillips, Grevillea **6:** 24. 1887.

RECENT TAXONOMIC TREATMENT:
Dennis (1974).

PREVIOUS MACARONESIAN RECORDS:
None.

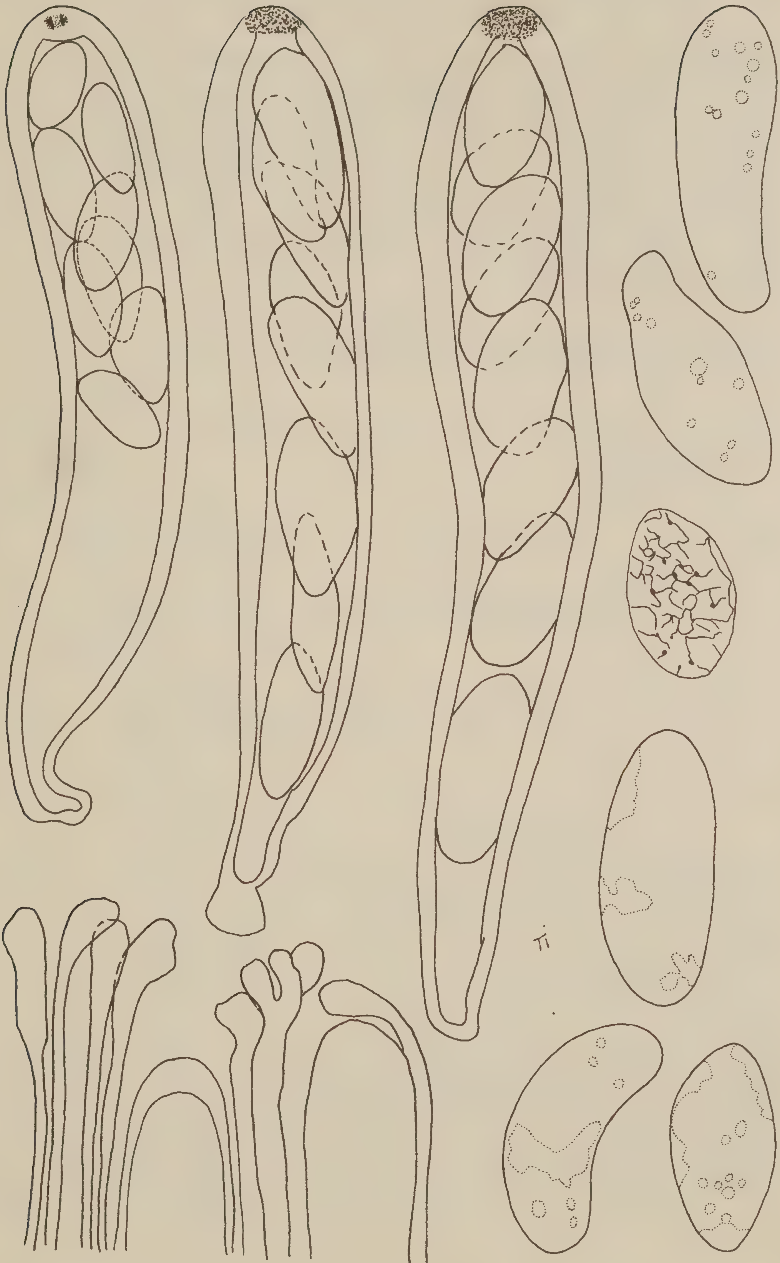
APOTHECIA solitary or gregarious, in tufts or groups frequently of 4 apothecia, erumpent, turbinate, with a 0.25-0.5 mm high basal portion, all surfaces pruinose. RECEPTACLE yellowish-beige, basal portions brownish. DISC concolorous with the receptacle, 0.75-1 mm diam. ECTAL EXCIPULUM at the flanks of textura globulosa to angularis, with cells turning outwards perpendicular to the exterior, end cells loosening; long celled at the margin. ASCI strongly J+ after rehydration for 5 minutes or longer in 2% aqueous KOH, more rapid after 10% KOH, broad cylindric-clavate with a short stipe, thick-walled, (108-) 148-164 (–176) x (17-) 21-24 (-26) µm, apical apparatus of several blueing rings in Melzer's Reagent. ASCOSPORES non-septate (but reported in the literature as up to 3-septate), partially biseriate to biseriate, broad-ellipsoid to broad-elliptic-fusoid, often unequally sided, sometimes with one end slightly hooked, with one to many guttules which may take irregular shapes and are separated by a refractive 3-dimensional internal reticulum at maturity (seen best in phase contrast), (15-) 21-27 (-33) x (7.3-) 8.8–13 (-15) µm. PARAPHYSES forming an epithecium, generally simple or sometimes branched, broader at the apex where 3.8–6.9 µm, 1.5 µm wide below.

TYPE LOCALITY:
Shropshire, England.

KNOWN MACARONESIAN DISTRIBUTION

CANARY ISLANDS
Tenerife. CUP-MM 106.

P. houghtonii, young ascus and 2 mature asci, all with ascospores; 6 ascospores, 1 mature spore showing refractive 3-dimensional internal reticulum as viewed in phase contrast; apices of asci and paraphyses; all CUP-MM 106, x1000.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SUBSTRATUM:
On branch of *Prunus lusitanica.*

Notes: An expanded description of this species is provided above, since none we found in the literature is satisfactory. Dennis (1974) reports dark brown discs and a non-pulverulent margin, characters we did not see in the Macaronesian collection. Ascospore septa were not seen in this collection, but these are reported as becoming triseptate by Phillips (1887) and illustrated as 0–1-septate by Dennis (1974). The blue reaction of the ascus pore in this species requires an unusually long rehydration pretreatment (5 minutes in 2% aqueous KOH).

4. Pezicula linda Korf, Mycotaxon **7:** 489. 1978, *descr. ampl.*

RECENT TAXONOMIC TREATMENT:
Korf (1978).

PREVIOUS MACARONESIAN RECORDS:
*Korf (1978), Beltrán (1980).

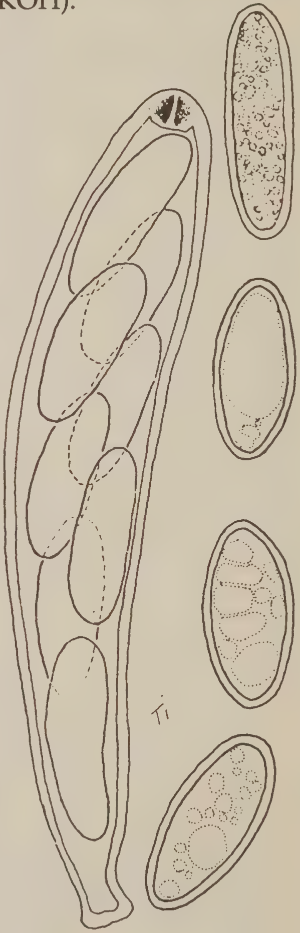
TYPE LOCALITY:
Fuente de las Pulgas, Las Yedras, Monte de las Mercedes, Tenerife, Canary Islands.

KNOWN MACARONESIAN DISTRIBUTION

CANARY ISLANDS
Tenerife. CUP-MM *264 (TFC).

SUBSTRATUM:
On cut wood.

Notes: Not mentioned in the description of this species by Korf (1978): ECTAL EXCIPULUM at the



P. linda, ascus with J+ pore; 4 ascospores; all CUP-MM 264, x1000.

margin of textura globulosa immersed in a gel, with round to irregular, and sometimes pyriform cells, 7.7-13.8 x 6.2-8.5 μm, intermixed with hyphae 3.0-6.3 μm wide, at the flanks a mixture of textura globulosa-prismatica immersed in a gel and of textura oblita, cells turning outwards, perpendicular to the surface of the receptacle. ASCUS PORE with several J+ rings turning blue in Melzer's Reagent. PARAPHYSES enlarged at the apex where 4.6-6.9 μm wide, 1.5-2.3 μm wide below.

5. **Pezicula rubi** (Lib.) Niessl in Rabenh., Fungi Europaei No. 2122. 1876.

RECENT TAXONOMIC TREATMENTS:
Bellemère (1967), Dennis (1974), Dennis (1978), Sharma & Rawla (1986), Pop (1987).

PREVIOUS MACARONESIAN RECORDS:
None.

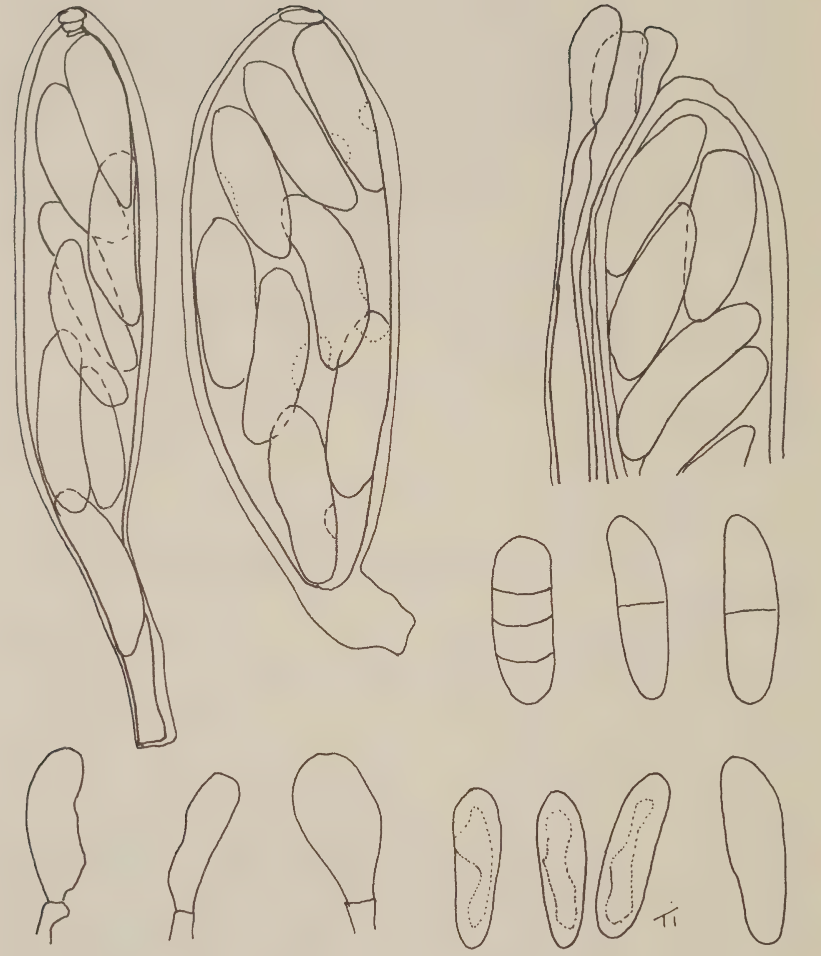
TYPE LOCALITY:
Ardennes, Belgium.

KNOWN MACARONESIAN DISTRIBUTION

MADEIRA
Madeira. CUP-MM 1633.
CANARY ISLANDS
Gomera. CUP-MM 1387.

SUBSTRATUM:
On stems of *Rubus* sp.

Notes: We find ascus width (19-) 22-28 (-30) μm, differing from that reported by Groves (1939), 12–15 (-17) μm, and by Dennis (1978), 20 μm, closer to that reported by Boudier (1911), 20–25 μm, and Dennis (1974), up to 25 μm. Asci have a strong J+ pore with 2% KOH pretreatment, sometimes with several rings blueing around the pore, and others with just a strong blue diffuse area around the pore of the ascus. Sometimes a longer 2% KOH pretreatment (1-2 min) is needed for the J+ reaction to develop in Melzer's Reagent. Quicker results are seen using 10% KOH, a treatment often distorting the apical apparatus. Paraphysis apices can be wider, (3.8-) 6.2–11 μm, than reported by Groves (1939) or Dennis (1978). There is an excellent set of illustrations by Boudier (1905-1911, plate 560 (as *Pezicula rhabarbarina* (Berk.) Tul.).



P. rubi, 2 mature asci with ascospores; apices of ascus and paraphyses; 3 paraphysis apices; 7 ascospores, all CUP-MM 1387, x1000.

LEPTOTROCHILA P. Karst. 1871

= *Fabraea* Sacc. 1882

Key to the known Macaronesian species

1. Apothecia arising from a stroma on living leaves of *Ranunculus;* ascospores with a submedian septum, 12–16 x 5.1-6.6 µm, narrower at one end .... **2. L. ranunculi**

1′. Apothecia on other substrates; ascospores aseptate or if 1 or more septate, septa not submedian 2

2 (1′). Apothecia on *Brunella vulgaris;* ascospores 9-15 x 3.5-5.0 µm, 0-4-septate .... **1. L. brunellae**

2′(1′). Apothecia not on *Brunella* 3

3(2′). Apothecia on *Rubia* or *Sherardia;* ascospores 10-15 x 2.9–4.4 µm, aseptate .... **4. L. verrucosa**

3′(2′). Apothecia on *Sanicula* .... **3. [Fabraea] saniculae**

1. Leptotrochila brunellae (Lind) Dennis, Brit. Ascom., rev. ed., p. 215. 1978.

≡ *Beloniella brunellae* Lind, Ann. Mycol. **5:** 274. 1907.

≡ *Fabraea brunellae* (Lind) Nannf., Trans. Brit. Mycol. Soc. **23:** 242. 1939.

RECENT TAXONOMIC TREATMENT:
Dennis (1978).

PREVIOUS MACARONESIAN RECORD:
*Viennot-Bourgin (1939).

TYPE LOCALITY:
Silkeborg, Jütland, Denmark.

KNOWN MACARONESIAN DISTRIBUTION

MADEIRA

Madeira. CUP-MM *1659 (ex Herb. Viennot-Bourgin in Lab. de Botanique et Path. Végétale, Paris-Grignon).

SUBSTRATUM:
On the base of stems, petioles, and leaves of *Brunella vulgaris*.

Notes: Spelling of the epithet in the literature varies, since the host genus is variously rendered as *Brunella* and *Prunella*. Viennot-Bourgin (1939) [as "*Beloniella prunellae* (Lind) emend. Rehm"] gives a complete description and drawings of the habit, of median sections of apothecia, and illustrations of hyaline, 1-2-celled ascospores (9-15 x 3.5-5.0 µm) for this collection. Korf examined the specimen, but saw no mature apothecia.

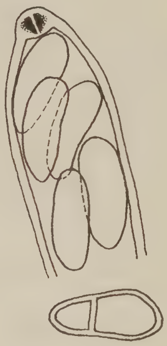
2. **Leptotrochila ranunculi** (Fr.) Schüepp, Phytopath. Z. **36:** 251. 1959.

≡ *Dothidea ranunculi* Fr., Syst. Mycol. **2**: 562. 1823.

RECENT TAXONOMIC TREATMENTS:
Schüepp (1959), Dennis et al. (1977), Dennis (1978), von Arx (1987).

PREVIOUS MACARONESIAN RECORD:
*Dennis et al. (1977).

TYPE LOCALITY:
Germany.



L. ranunculi, ascus apex with strong J+ reaction; ascospore with submedian septum; all CUP-MM 1693, x1000.

KNOWN MACARONESIAN DISTRIBUTION

MADEIRA
Madeira. CUP-MM 1596, *1693 (K).

SUBSTRATA:
On living leaves of ?*Ranunculus* cfr. *repens;* on *Ranunculus repens.*

Notes: Schüepp (1959) has illustrations and a detailed description of this fungus. The ascus pore blues in Melzer's Reagent even without KOH-pretreatment.

3. **[Fabraea] saniculae** (Wallr.) Rehm in Rabenh., Krypt.-Fl. **1**(3): 603, 1892.

= *Phlyctidium saniculae* Wallr., Fl. crypt. Germ. **2:** 419, 1833.

RECENT TAXONOMIC TREATMENTS:
None

PREVIOUS MACARONESIAN RECORDS:
*Arwidsson (1940), **Dennis et al. (1977).

TYPE LOCALITY:
Thüringen, Germany.

KNOWN MACARONESIAN DISTRIBUTION

AZORES
São Jorge. CUP-MM * **1653 (S), * **1656 (GB), presumably both are parts of the same collection.

SUBSTRATUM:
On *Sanicula azorica.*

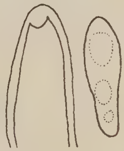
Notes: Rehm (1892) repeats the original description. No apothecia were found in either Macaronesian specimen. Both collections were made by Persson on the same day and same locality. Arwidsson (1940) did not provide a description or drawings. Dennis et al. (1977) did not see the specimen. The species may be lost, and its placement here under *Leptotrochila* is tentative.

4. **Leptotrochila verrucosa** (Wallr.) Schüepp, Phytopath. Z. **36:** 257, 1959.

≡ *Colpoma verrucosum* Wallr., Fl. crypt. Germ. **2:** 422. 1833.

RECENT TAXONOMIC TREATMENTS:
Schüepp (1959), Dennis at al. (1977).

PREVIOUS MACARONESIAN RECORDS:
*Viennot-Bourgin (1939) [as *Pseudopeziza repanda* (Fr.) Karst.]; **Dennis et al. (1977).



L. verrucosa, ascus tip; one ascospore; all CUP-MM 1658, x1000.

TYPE LOCALITY:
Germany.

KNOWN MACARONESIAN DISTRIBUTION

AZORES
São Miguel. CUP-MM **1691 (K).
Terceira. CUP-MM **1692 (K).
MADEIRA
Madeira. CUP-MM *1658 (Herb. Viennot-Bourgin in Lab. de Botanique et Path. Végétale, Paris-Grignon).

SUBSTRATA:
On *Rubia peregrina*, on *Sherardia arvensis*.

Notes: Schüepp (1959) provided a detailed description and drawings. We follow him in recognizing that *L. repanda* (Fr.) Karst. is distinct from *L. verrucosa*, the epithet applied by Viennot-Bourgin (1939) when he reported this from Macaronesia. The asci blue in Melzer's Reagent even without KOH-pretreatment.

TROCHILA Fr. 1849

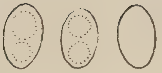
Key to the known Macaronesian species

1. Apothecia on *Prunus;* ascospores 6-7 x 4-4.5 µm **3. T. laurocerasi**
1′. Apothecia on other substrates; ascospores larger 2
  2(1′). Apothecia on *Hedera helix*; ascospores 8 x 5 µm **1. T. craterium**
  2′(1′). Apothecia on *Ilex*; ascospores 9 x 4.3-4.5 µm **2. T. ilicina**

1. **Trochila craterium** (DC.) Fr., Summa veg. Scand. p. 367. 1849.

≡ *Sphaeria craterium* DC., Fl. franç. **2:** 298. 1805.
≡ *Sphaeria punctiformis* β *hederae* Pers., Syn. meth. fung. p. 90. 1801.

RECENT TAXONOMIC TREATMENTS:
Greenhalgh & Morgan-Jones (1964), Bellemère (1967), Hein (1976), Dennis (1978).



T. craterium, 2 biguttulate ascospores; 1 mature ascospore; all CUP-MM 1177, x1000.

PREVIOUS MACARONESIAN RECORDS:
None.

TYPE LOCALITY:
Europe ?

KNOWN MACARONESIAN DISTRIBUTION

CANARY ISLANDS
Tenerife. CUP-MM 1177.

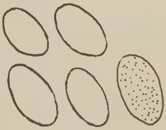
SUBSTRATUM:
On the underside of dead leaves of *Hedera helix*.

Notes: Rehm (1888) gives a description and illustrations of this species. Ascospores in our collection are biguttulate when young, and non-guttulate at maturity when the spores turn brown. Greenhalgh & Morgan-Jones (1964) report oil globules in "slightly immature asci," and some brownish spores in one collection they examined.

2. Trochila ilicina (Nees : Fr.) Greenh. & Morgan-Jones, Trans. Brit. Mycol. Soc. **47**: 312. 1964.

RECENT TAXONOMIC TREATMENTS:
Greenhalgh & Morgan-Jones (1964), Dennis (1978), Krieglsteiner (1982), Breitenbach & Kränzlin (1984).

PREVIOUS MACARONESIAN RECORD:
*Urries (1957) [as "*T. ilicis* (Chev.) Crouan"].



T. ilicina, 4 hyaline ascospores; 1 mature brown ascospore; all CUP-MM 2546, x1000.

TYPE LOCALITY:
Vosges, France [lectotype].

KNOWN MACARONESIAN DISTRIBUTION

CANARY ISLANDS
Gran Canaria. CUP-MM *2546 (MA 12974).

SUBSTRATUM:
On leaves of *Ilex canariensis*.

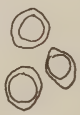
Notes: Rehm (1888) [as "*Trochila ilicis* (Chev.) Cr."] gives a description and drawings. Our collection has a few medium brown ascospores. Greenhalgh & Morgan-Jones (1964) also reported such spores in one collection from the Fries herbarium. We saw ascospores slightly wider (4.3–5.4 µm) than do other authors, but we included the measurements of mature brown ascospores.

3. **Trochila laurocerasi** (Desm.) Fr., Summa veg. Scand. II, p. 367. 1849.

≡ *Phacidium laurocerasi* Desm., Pl. crypt. N. France I, No. 188. 1826.

RECENT TAXONOMIC TREATMENTS:
Greenhalgh & Morgan-Jones (1964).

PREVIOUS MACARONESIAN RECORD:
*Urries (1957).



T. laurocerasi, 3 ascospores; all CUP-MM 2550, x1000.

TYPE LOCALITY:
Northern France.

KNOWN MACARONESIAN DISTRIBUTION

CANARY ISLANDS
Tenerife. CUP-MM *2550 (MA 12973).

SUBSTRATA:
On leaves of *Prunus lusitanica*.

Notes: We record ascospores shorter and broader (5.9-6.6 x 4.1–4.4 µm) than do Rehm (1888), 7-10 x 3.5-4 µm, or Greenhalgh & Morgan-Jones (1964), 7.5-10 x 3–3.75 µm.

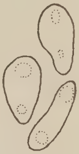
PSEUDOPEZIZA Fuckel, 1870

One known Macaronesian species

1. **Pseudopeziza trifolii** (Biv. : Fr.) Fuckel, Jahrb. Nassauischen Vereins Naturk. **23-24**: 290. 1870.

RECENT TAXONOMIC TREATMENTS:
Schüepp (1959), Bellemère (1967), Dennis (1978), Breitenbach & Kränzlin (1984), von Arx (1987).

PREVIOUS MACARONESIAN RECORDS:
*Dennis et al. (1977), †Spegazzini (1915) [as *P. medicaginis*].



P. trifolii, 3 ascospores; all CUP-MM 1677, x1000.

TYPE LOCALITY:
Sicily, Italy.

KNOWN MACARONESIAN DISTRIBUTION
AZORES
Terceira. CUP-MM *1676 (K), *1678 (K).
São Miguel. *1677 (K).
†CANARY ISLANDS
†Gran Canaria.

SUBSTRATA:
On *Trifolium repens*, on *Medicago sativa*.

Notes: Rehm (1892) has a description and drawings. Though Schüepp (1959) recognizes *formae speciales* for collections occurring on different hosts, we do not recognize those distinctions.

MYCOTAXON

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A REVISION OF THE GENUS *DALDINIA*

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ABSTRACT

Nineteen species of ***Daldinia*** are recognized. Six of them --- ***Daldinia bambusicola***, ***D. brachysperma***, ***D. gelatinosa***, ***D. macrospora***, ***D. mexicana***, and ***D. petriniae*** --- are newly described. One new combination, ***Daldinia lloydii***, is made. Seven species were cultured. ***Daldinia caldariorum*** produced the teleomorph in culture. A key to the accepted ***Daldinia*** species and an annotated list of the published ***Daldinia*** epithets are provided.

Key words: ***Daldinia***, systematics, Xylariaceae

The genus ***Daldinia*** Ces. & De Not. was named to honor Agostino Daldini (1817-1895), a Catholic monk who lived near Locarno, Switzerland and who was a friend of Cesati and De Notaris (Crivelli et al., 1981). It is a small assemblage of perhaps 19 species. Some of the species seem uncommon and are thus not frequently encountered. Others, such as ***D. concentrica*** (Bolton: Fr.) Ces. & De Not. --- the type of the genus --- and some taxa frequently confused with it are common in North America, Europe, and elsewhere. This fungus is conspicuous because of its relatively large size (several cm in diameter and height) and its internal structure of alternating light-colored and dark-colored rings. Thus, it has long been known to man and probably fascinated him through most of his tenure near temperate angiospermous forests. Saccardo (1910) listed 24 sources of illustrations of ***D. concentrica*** and, since then, it has been depicted many more times. Among the larger pyrenomycetes ***D. concentrica*** and its ilk are rivalled only by the larger ***Xylaria*** species in general recognizability. Because of the common occurrence of ***D. concentrica*** and allies, it is not surprising that a certain folklore has grown up about them. Stromata of ***D. concentrica*** have been called "cramp balls" in Great Britain because carrying them on one's person is reputed to prevent or relieve leg cramps (Ainsworth, 1976). They have also been called "King Alfred's cakes" because of their supposed resemblance to some pastries that this Saxon king reputedly burnt while falling asleep during a baking session. They have also been considered as a type of puff ball from time to time.

Daldinia species, like many other wood-decaying pyrenomycetes and many polyporaceous and agaricaceous basidiomycetes, wall themselves off in host wood by forming irregular sac-like structures. These structures are composed of conspicuous dark hyphae. In wood cuts, sections of these sacs appear as brown to black lines --- often called zone lines --- or sheets. Wood so colonized is badly decayed, but retains enough integrity to be made into small items such as hair clasps, brooches, jewelry boxes, etc. The wood, called "spalted wood" or "calico wood", is often very striking with its ornamentations of dark lines and figures. Panisset (1929) proved that "calico wood" in European ash is caused by ***D. concentrica***.

HOSTS AND HOST-FUNGUS RELATIONSHIPS

Daldinia species are probably exclusively angiosperm associates. In the recent compendium on fungi on plants and plant products in the US, ***Daldinia concentrica*** is listed on 21 dicot host genera and ***D. vernicosa*** (Schwein.) Ces. & De Not. --- considered a synonym of ***D. fissa*** C. G. Lloyd herein --- is reported on 17 dicot host genera (Farr et al., 1989). A report of ***D. concentrica*** on bamboo represents an erroneous identification (see later). Host records for ***D. concentrica*** and taxa likely to be confused with it, such as ***D. petriniae*** Y.-M. Ju, J. D. Rogers, & San Martín in Europe, show great similarity to those from the US (Cannon et al., 1985; Petrini and Müller, 1986; Saccardo, 1897). Several species are known only from monocots. These include ***D. bambusicola*** Y.-M. Ju, J. D. Rogers, & San Martín, ***D. graminis*** Dargan & Thind, and ***D. sacchari*** Dargan & Thind.

There seems to be at least some host specificity among those ***Daldinia*** species occurring on woody dicots. ***Daldinia concentrica*** occurs very commonly on ***Fraxinus*** in Great Britain (Cannon et al., 1985) and is frequently encountered on ***Betula*** species in the beech-birch-maple forests of northern US and Canada (personal observation, JDR). Whalley and Watling (1980) reported ***D. vernicosa*** as highly specific for burnt ***Ulex*** wood in Great Britain. That fungus is considered to be ***D. caldariorum*** Henn. herein, but it seems possible that it is a distinct taxon based upon its great host specificity (Whalley and Watling, 1980).

Daldinia concentrica, like most if not all xylariaceous fungi, causes a white rot of host wood, i.e., both cellulose and lignin are degraded (Cartwright and Findlay, 1950; Rogers, 1979). The decay caused by xylariaceous fungi is very similar to those caused by white-rotting basidiomycetes (Sutherland and Crawford, 1981). Merrill et al. (1964) found that sterile wood blocks are decayed more slowly by ***D. concentrica*** than by some basidiomycetes, but the appearance is similar. Nilsson and Daniel (1989) reported that ***D. concentrica*** caused a weight loss of 62.9% in birch (***Betula***) wood after 2 months exposure to the fungus. Panisset (1929), in proving ***D. concentrica*** to be the cause of "calico wood" in ash (***Fraxinus excelsior***), has given a good account of the microscopical aspects of decay.

Daldinia species are probably weak facultative parasites that continue to decay the wood following decline and death of their hosts. Hepting (1971), in his monumental review of diseases of forest and shade trees in the United States, makes only one reference to ***Daldinia*** --- an unidentified species on declining oaks. It thus appears that there is no concern about ***Daldinia*** species as damaging pathogens, at least in the US. Boddy et al. (1985) have shown ***D. concentrica*** to be a common inhabitant of branches of ***Fraxinus excelsior*** in Great Britain. They suggest that it is a primary colonizer, perhaps remaining latent for a period prior to extensive colonization.

ECOLOGY

Ingold (1946, 1965) was the first to recognize that ***Daldinia***, as represented by ***D. concentrica***, is ecologically and physiologically xerophytic. He noted that stromata, detached from their host and brought indoors, will discharge ascospores for 3 or 4 weeks without additional water. The density of the stroma declines from just above 1.0 to about 0.3, i.e., through loss of water from the stroma. Stromata placed in a desiccator over anhydrous calcium chloride continue to discharge ascospores for many days (Ingold, 1965). He noted that a stroma attached to a tree remains active much longer than a detached one, one stroma on a trunk discharging ascospores from 3 May through 17 September, 138 days. He noted that ***Daldinia***, with a summer discharge period, differs from most other lignicolous pyrenomycetes that discharge their ascospores in autumn when conditions are more humid (Ingold, 1965). This was attributed to the curious water relations of the fungus. Walkey and Harvey (1968) noted that ***D. concentrica*** discharged ascospores continuously for 47 days, including 22 days without rain. Ingold (1965) showed that in ***Daldinia*** --- as in ***Hypoxylon fuscum*** (Pers.: Fr.) Fr. --- ascospore discharge is nocturnal, but the diurnal rhythm of spore discharge can be manipulated by altering light exposure patterns. Discharge of ascospores at night coupled with observations that ascospores can germinate within a few hours after discharge (JDR), is probably advantageous in that they can take advantage of night dew for hydration, i.e., even in areas where rainfall is sporadic or does not correlate with the life cycle of the fungus. It has also been noted in the literature (e.g., Tulasne and Tulasne, 1863; Panisset, 1929) that ascospores of ***D. concentrica*** ooze from ostioles in long cirrhi during wet weather. These spores are probably dispersed by splashing rain, in contrast with those discharged during dry conditions which are disseminated by wind. ***Daldinia concentrica*** and some (probably all) other species produce conidia on young stromata and/or on invaded substrates. Conidia are dry and wind-disseminated. They germinate at high percentages in water.

It is our opinion that the concentric rings in ***Daldinia*** stromata are the key to its xerophytic habit. When rings are initially formed they tend to be dense and more or less gelatinous. As stromata age the rings tend to lose their density and collapse or at least become riddled with lacunae. The gel part of the rings probably holds water that is in some way released to the fungus as required. The waxy to carbonaceous crust encasing the ringed stroma and bearing the perithecia probably retards evaporation from the interior. While the stroma is still attached to its substrate, water produced during metabolism of cellulose and glucose is likely recycled to the stroma. Moreover, the white-rotted wood itself becomes an effective water-holding reservoir that is potentially available to the fungus. Bayliss-Elliott (1920) produced evidence indicating that the successive rings in stromata of ***D. concentrica*** are regions of abortive perithecia. If this is true, then the fungus might be looked upon as sacrificing successive potential crops of perithecia to ring formation in order to assure that the maturing final crop will have sufficient water to discharge its ascospores. However, our studies of teleomorphic ***D. caldariorum*** cause us to question the universality of this phenomenon (see NOTES on ***D. caldariorum***). Bayliss-Elliott (1920) also noted that stromata last only one year, being mined by slugs. We also have noted that old ***Daldinia*** stromata are inevitably riddled by insects. It is probable that some proportion of the ascospores in old stromata are disseminated by beetles and other animals.

Although records of ***Daldinia*** distributions are incomplete, they do seem to indicate the xerophytic nature of the genus. Perhaps the greatest diversity in terms of numbers of ***Daldinia*** species occurs in Mexico (San Martín, 1992; Pérez-Silva, 1973). Much of this country is warm and dry. Even those species that occur principally in more mesic hardwood belts are subjected to periods of scarce free moisture. The propensity of ***D. vernicosa*** in the US (***D. fissa*** herein) and ***D. vernicosa*** in Great Britain (***D. caldariorum*** herein) to colonize burned material (Rhoads, 1918; Whalley and Watling, 1980) indicates that these fungi are present in areas that are dry enough to burn frequently, another indication of their xerophytic lifestyles. Finally, Boddy et al. (1985) found that, in culture, ***D. concentrica*** was more tolerant of low water potentials than some potentially competitive basidiomycetes. This, again, suggests the essentially xerophytic nature of this species and the genus as a whole.

DEVELOPMENTAL ASPECTS OF ***DALDINIA***

Bayliss-Elliott (1920) provided some of the gross features of stromatal development, including ring formation. Perithecial development has apparently not been studied in great detail, but Ingold (1954) described the ascogenous system. It is extensive, the nonseptate ascogenous hyphae elongating via fusions of crozier ultimate and antepenultimate cells. The young perithecium is eventually criss-crossed with ascogenous hyphae in a basket-weave fashion (Ingold, 1954).

Ascospores of ***D. concentrica*** have a hyaline dehiscent outer wall or perispore. This feature was probably first noted by Molliard (1904) and has been noted by several other authors. Beckett (1976a, 1976b) provided microscopic and ultrastructural details on dormant and germinating ascospores of ***D. concentrica***. Ascospores of ***D. concentrica*** are uninucleate when formed and become binucleate via a mitotic division

(Rogers, unpublished). One of the two nuclei then disintegrates; maturing ascospores are uninucleate. Nuclear behavior in ascospores of ***D. concentrica*** thus resembles that reported in several ***Hypoxylon*** species (Ju and Rogers, 1996; Rogers, 1979).

The anamorph of ***Daldinia*** species, where known, is referable to ***Nodulisporium*** Preuss. Tulasne and Tulasne (1863) illustrated the anamorph of ***D. concentrica*** and noted its occurrence on young stromata. Bayliss-Elliott (1920) found conidia only on very small and immature stromata. Molliard (1904) did an extensive study of the anamorph of ***D. concentrica*** and Panisset (1929) also dealt with it. The latest description of ***Daldinia*** anamorphs is that of Petrini and Müller (1986). In any case, it is well-known that the anamorph is not confined to young stromata in nature, but is often produced extensively on woody substrates.

Essentially nothing is known about the genetics of ***Daldinia*** species. Sharland and Rayner (1986) believe that results from cultural experiments indicate a mycelial recognition system in ***D. concentrica*** similar to those governing mating in heterothallic Basidiomycetes. In ***Daldinia***, however, a stable secondary mycelium is not produced.

SECONDARY METABOLITES AND STROMATAL PIGMENTS

Stromatal pigments, or the lack of such pigments, are useful in delimiting genera in the Xylariaceae (Whalley and Edwards, 1995) and in delineating taxa in ***Hypoxylon*** Bull. (Ju and Rogers, 1996) and in ***Daldinia*** herein. Stromatal pigments are secondary metabolites or are synthesized from them. Secondary metabolites have not been as widely used as they might be owing to a reputation for sensitivity to environment and general lack of chemical understanding (Whalley and Edwards, 1995). The main coloring agents in the ***Hypoxylon fragiforme*** (Pers.: Fr.) J. Kickx fil. teleomorph is said to be mitorubrin (Whalley and Edwards, 1995) and the same or related compounds are probably to be found in ***Daldinia***. Whalley and Edwards (1995) cited papers of Allport and Bu'lock dealing with different secondary metabolites of ***D. concentrica*** from ascomata and from cultures, respectively. Whalley and Edwards (1995) note that the presence of naphthalene compounds in ***Entonaema*** A. Möller and ***Daldinia*** reinforce Rogers' conviction (1982) that these genera are closely related.

Shigo (1974) has shown that care must be taken with the methodology employed in evaluating pigments. He showed that filtrate and mycelium of ***D. concentrica*** is green under standard culturing conditions, but is colorless in media amended with manganese. He conjectured that ***D. concentrica*** and some other wound-invading fungi are aggressive wound invaders adapted to high concentrations of minerals that accumulate in tissues as they die, discolor, and decay (Shigo, 1974). The high concentration of minerals may affect pigmentation of some fungi and also the color of the wood (Shigo, 1974).

As will be seen later herein, some stromata of a given species produce extractable pigments and others do not. This is thought to be owing primarily to changes occurring during stromatal aging, but substrate could also be a factor.

GENERIC AFFINITIES AND EVOLUTION

The genera most closely allied to ***Daldinia*** appear to be ***Hypoxylon*** and ***Entonaema***. It is conceptually easy to derive ***Daldinia*** from ***Hypoxylon*** by development of a zonate ring structure in the stroma of the former. This might have come about under the selective influence of dry environments on capacity for stromatal water storage. As discussed earlier herein, if rings truly represent, in part, abortive attempts to form perithecia, then regular abortion in favor of rings was probably selected, i.e., because of the presumed value of rings in storing water. ***Entonaema*** stores liquid water under pressure. The water presumably fills an expanding cavity with gel-lined walls. It seems possible that ***Entonaema*** has dispensed with rings altogether, using turgor pressure generated by gels to both expand the stroma and store water.

The relationships among ***Daldinia***, ***Hypoxylon***, and ***Entonaema*** are indicated by pigmented stromata, by ***Nodulisporium*** type anamorphs, by ascus ring morphology (broader than high), and by ascospore germ slit placement on the convex side of the ascospore (see Rogers, 1982). The presence of naphthalene compounds in ***Daldinia*** and ***Entonaema*** further indicate a close relationship (Whalley and Edwards, 1995).

Laessøe (1994) has reflected the views of various workers in suggesting that ***Daldinia*** should be merged with ***Hypoxylon***. Although these genera are undoubtedly closely related, their lifestyles seem somewhat different (see earlier herein). We believe that the biology of these genera should be taken into strong account in taxonomic matters.

Another genus with possible affinities with ***Daldinia*** is ***Rhopalostroma*** D. Hawksw. The stipitate stromata bearing perithecia beneath an outer crust, ascospore morphology, and robust ***Nodulisporium*** anamorph (proven in one species) (Hawksworth, 1977; Hawksworth and Whalley, 1985) are suggestive of ***Daldinia***. The interior flesh, however, lacks distinct rings and asci lack an apical ring, usually deliquescing and presumably lacking the capacity to forcibly discharge ascospores (Hawksworth, 1977; Hawksworth and Whalley, 1985). It is probable that this African-Asian genus developed from a ***Hypoxylon***-like ancestor and is going the direction of cleistocarpy. That is, the deliquescing asci and the friable perithecial layer of some ***Rhopalostroma*** species suggest that, in addition to ascospores passively discharged from ostioles during wetting, ascospores might be exposed during ascomatal disintegration and wind-disseminated. This is reminiscent of ***Pulveria*** Malloch & Rogerson [= ***Pyrenomyxa*** Morg.] and ***Phylacia*** Lév., cleistocarpous genera that have lost both the perithecial ostioles and forcible ascospore discharge. As Hawksworth (1977) pointed out, ***Rhopalostroma*** asci also have a certain resemblance to those of ***Thamnomyces*** Ehrenb.

Daldinia Ces. & De Not., Comment. Soc. Crittog. Ital. 1: 197. 1863; [*nom. cons.*].

Type: ***D. concentrica*** (Bolton: Fr.) Ces. & De Not. [≡ ***Sphaeria concentrica*** Bolton: Fr.]

≡ ***Peripherostoma*** S. F. Gray, Nat. Arr. Brit. Pl. I, p. 513. 1821; [*nom. rejic.*, ICBN Art. 14.4].

Lectotype [*fide* Greuter (1988)]: ***P. concentricum*** (Bolton: Fr.) S. F. Gray [≡ ***Sphaeria concentrica*** Bolton: Fr.]

≡ ***Stromatosphaeria*** Grev., Fl. Edinensis, p. 355. 1824; [*nom. rejic.*, ICBN Art. 14.4].

Lectotype [*fide* Greuter (1988)]: ***Sphaeria concentrica*** Bolton: Fr.

≡ ***Hemisphaeria*** Klotzsch, Acad. Caes. Leop. Nova Acta 19: 241. 1843; [*nom. rejic.*, ICBN Art. 14.4].

Type: ***H. concentrica*** (Bolton: Fr.) Klotzsch [≡ ***Sphaeria concentrica*** Bolton: Fr.]

Stromata spherical, depressed-spherical, placentiform, peltate, turbinate, clavate, or cylindrical, sessile, subsessile to definitively stipitate, solitary to aggregated, smooth or with inconspicuous to conspicuous perithecial mounds; surface colored, darkened and dull or blackened and varnished in age; dark, waxy granules immediately beneath surface, with or without KOH-extractable pigments; the tissue between perithecia pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, the lighter zones white, gray, brown to dark brown, pithy, woody, or gelatinous, persistent or disintegrating. Perithecia obovoid to tubular. Ostioles inconspicuous, punctate, slightly papillate, or papillate. Asci eight-spored, cylindrical, stipitate, early deliquescent to persistent, with ascospores arranged uniseriately or partially biseriately, with apical ring discoid, amyloid. Ascospores light brown, brown, or dark brown, unicellular in both mature and immature states, ellipsoid, inequilateral or nearly equilateral, with narrowly or broadly rounded ends, with straight or slightly sigmoid germ slit spore-length on more convex or, infrequently, less convex side; perispore dehiscent or indehiscent in 10% KOH, smooth; epispore smooth.

NOTES: Stromatal shape is fairly uniform among ***Daldinia*** taxa, usually placentiform, spherical, or depressed-spherical and sessile to subsessile. The exceptions are ***D. clavata***, ***D. cudonia***, and ***D. cuprea*** which frequently produce stipitate, cylindrical to clavate stromata. The stromatal surface is usually smooth. A given species often has a smooth stromatal surface in some collections and a surface with inconspicuous to conspicuous perithecial mounds in others. ***Daldinia cuprea*** has very conspicuous perithecial mounds. ***Daldinia lloydii*** is peculiar in having a squamulose surface. The lighter concentric zones of stromata are of great taxonomic value in terms of their consistency and color. Two types of the lighter concentric zones are found among ***Daldinia*** species: one type is brown, grayish brown, or, less frequently, whitish, pithy to woody, persistent; the other type is whitish, gelatinous, disintegrating and, when dry, becoming loculate with locules separated by translucent membranous material. Most species yield purplish stromatal pigments in KOH, but some collections of these species lack KOH-extractable pigments. ***Daldinia bakeri***, ***D. concentrica***, and ***D. mexicana*** yield greenish to yellowish pigments in KOH. ***Daldinia cuprea*** yields dark mouse gray pigments in KOH.

Dargan and Thind (1984) erected subgenera ***Eu-Daldinia*** Dargan & Thind and ***Ento-Daldinia*** Dargan & Thind based upon stromatal anatomy. We were unable to observe differences with sufficient consistency to assign taxa to one or to the other of these subgenera. We thus do not recognize subgenera herein. Many specimens observed by us, however, were overmature. Study of fresh specimens in their prime might cause us to reconsider the subgeneric concept of Dargan and Thind (1984).

Perithecia are tubular in most species. Collections of some species with small stromata, e.g., ***Daldinia caldariorum***, tend to have obovoid perithecia. Although Child (1932) claimed that the perithecia of ***D. grandis*** are polystichous, we failed to detect it among the collections of this fungus that we studied.

Asci tend to dissolve early and were therefore not found in a great number of studied specimens. When asci were observed, they were long-stipitate and had a flattened apical ring bluing in iodine.

Ascospores are either regular or variable in shape in a given species. When a species has regular ascospores, they are strongly inequilateral and have a dehiscent perispore. When a species has variable ascospores, they range from equilateral, slightly inequilateral to strongly inequilateral and usually have an indehiscent perispore. It should be noted that, although the ascospore perispore appears smooth by light microscopy, coil-like ornamentation has been shown by electron microscopy in some species with a dehiscent perispore, e.g., Beckett (1976a, 1976b) and Van der Gucht (1993). The ascospore germ slit is spore-length to, infrequently, slightly less than spore-length in all ***Daldinia*** species.

Anamorphs of ***Daldinia*** species resemble those of ***Hypoxylon*** species and are referable to ***Nodulisporium*** Preuss. The conidiogenous structure of a given ***Daldinia*** species can have a ***Sporothrix***-like, ***Virgariella***-like, ***Nodulisporium***-like, or ***Periconiella***-like branching pattern as defined in Ju and Rogers (1996). In most species, conidia are produced holoblastically in a sympodial sequence. The conidiogenous cells of ***D. petriniae*** are peculiar in proliferating percurrently and becoming annellated as a consequence. It is uncommon to find conidia produced holoblastically in ***D. petriniae***.

KEY TO TAXA OF ***DALDINIA****

1. Stromata known only from monocots 2
1. Stromata known from dicots, rarely or never monocots 4

    2. Ascospores 8.5-11 x 4-5 µm; perispore dehiscent in KOH ....
    .... ***D. bambusicola***

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* Color codes in descriptions follow Rayner (1970).

2. Ascospores larger; perispore indehiscent in KOH 3

3. Ascospores 15.5-18 x 6.5-7.5 μm, with germ slit spore-length .... ***D. sacchari***

3. Ascospores 20-26 (-30) x 7.5-9 μm, with germ slit much less than spore-length...***D. graminis***

4. Stromatal pigments extracted in KOH dark mouse gray (119); perithecial mounds usually conspicuous; ascospores 10-11.5 x 4.5-5.5 μm ....***D. cuprea***

4. Stromatal pigments extracted in KOH other than above; perithecial mounds usually inconspicuous or lacking 5

5. Stromatal pigments extracted in KOH olivaceous, greenish, yellowish, or ochraceous [isabelline (65), hazel (88), honey (64), amber (47), or cinnamon (62)]...6

5. Stromatal pigments extracted in KOH dark livid (80), vinaceous gray (116), livid purple (81), vinaceous purple (101), livid violet (79), or lacking 8

6. Lighter concentric zones of stromata brown, grayish brown, or, less frequently, whitish, pithy to woody, persistent; ascospores 12-16 x 5.5-7.5 μm; perispore dehiscent in KOH.....................***D. concentrica***

6. Lighter concentric zones of stromata whitish, gelatinous, disintegrating and, when dry, becoming loculate with locules separated by translucent membranous material; perispore dehiscent or indehiscent in KOH 7

7. Ascospores equilateral, slightly inequilateral, to, less frequently, inequilateral, variable, with broadly to narrowly rounded ends, 13-17 x 7.5-8.5 μm; perispore indehiscent in KOH ....***D. bakeri***

7. Ascospores strongly inequilateral, more or less uniform in shape, with narrowly rounded ends, 12.5-15.5 x 6.5-7.5 μm; perispore dehiscent in KOH... ***D. mexicana*** *sp. nov.*

8. Lighter concentric zones of stromata brown, grayish brown, or, less frequently, whitish, pithy to woody, containing gelatinous material in younger stages of some species, persistent or becoming fibrous and loosening in some species 9

8. Lighter concentric zones of stromata whitish, gelatinous, disintegrating and, when dry, becoming loculate with locules separated by translucent membranous material 17

9. Ascospores equilateral, slightly inequilateral, to, less frequently, inequilateral, highly variable in shape, with broadly to narrowly rounded ends; perispore usually indehiscent or, infrequently, dehiscent in KOH...... 10

9. Ascospores strongly inequilateral, more or less uniform in shape, with narrowly rounded ends; perispore always dehiscent in KOH 12

10. Ascospores 8-11 (-12) x 4-5.5 μm, with the germ slit usually on the less convex side .... ***D. caldariorum***
10. Ascospores larger, with the germ slit usually on the more convex side 11

11. Ascospores 11-14 (-15.5) x 6-8 (-8.5) μm .... ***D. loculata***
11. Ascospores 14-22 (-25.5) x 7-11 μm.. ***D. grandis***

12. Stromatal surface covered with ochraceous brown, polygonal scales; ascospores 12-16 x 6-7.5 μm .... ***D. lloydii*** *nom. nov.*
12. Stromatal surface lacking scales 13

13. Ascospores 6.5-7.5 x 3-4 μm.......................... ***D. brachysperma*** *sp. nov.*
13. Ascospores larger 14

14. Stromata turbinate to clavate, with a slender stipe less than 5 mm diam; ascospores 12.5-16.5 (-19.5) x 6-8 μm .... ***D. cudonia***
14. Stromata sessile, subsessile, if stipitate, the stipe more than 5 mm diam 15

15. Stromata cylindrical; ascospores 8-11.5 x (3.5-) 4-5.5 μm .... ***D. clavata***
15. Stromata other than cylindrical 16

16. Ostioles obsolete, or slightly papillate; ascospores 10-14 (-15.5) x 5-6.5 μm; conidia produced holoblastically in sympodial sequence, 4.5-6.5 x 2.5-3 μm; widespread in the tropics and subtropics.................... .... ***D. eschscholzii***
16. Ostioles papillate; ascospores 12.5-16.5 x (6-) 6.5-7.5 μm; conidia produced from percurrently proliferating conidiogenous cells or, infrequently, from sympodially proliferating conidiogenous cells, (5.5-) 7-9 x (4.5-) 5-6 (-7) μm; known only from Europe .... ***D. petriniae*** *sp. nov.*

17. Ascospores slightly inequilateral to equilateral, with broadly to narrowly rounded ends, 11.5-15.5 x 6.5-9 μm; perispore indehiscent or, infrequently, dehiscent in KOH .... ***D. fissa***
17. Ascospores strongly inequilateral, more or less uniform in shape, with narrowly rounded ends; perispore dehiscent in KOH............................. 18

18. Ascospores 22.5-30 x 8.5-10.5 μm................ ***D. macrospora*** *sp. nov.*
18. Ascospores 12.5-15.5 x 6-7.5 μm...................... ***D. gelatinosa*** *sp. nov.*

Daldinia bakeri C. G. Lloyd, Mycol. Writings 5, Large Pyrenomycetes: 25. 1919. Figs. 1, 18-20

Stromata placentiform, sessile, smooth or with inconspicuous perithecial mounds, 5.4 cm diam x 3.8 cm high; surface blackened with reddish brown tone, varnished; dull reddish brown granules immediately beneath surface, with KOH-extractable pigments dilute honey (64) or isabelline (65); the tissue between perithecia brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.2 mm thick, the lighter zones whitish, gelatinous, disintegrating and becoming loculate when dry, 1.3-2 mm thick. Perithecia tubular, 0.3-0.4 mm diam x 1 mm high. Ostioles slightly papillate. Asci not observed. Ascospores dark brown to blackish brown, unicellular, ellipsoid, slightly inequilateral to equilateral, with broadly to narrowly rounded ends, 13-17 x 7.5-8.5 μm, with straight germ slit spore-length on more convex side; perispore indehiscent in 10% KOH; epispore smooth.

Anamorph unknown.

SPECIMEN EXAMINED: AUSTRALIA: Sydney, 1901, Baker, R. T., wood (BPI 716970 [Lloyd herb. 12377], HOLOTYPE of ***Daldinia bakeri***).

NOTES: This fungus greatly resembles ***D. fissa*** but differs from the latter primarily in having dilute honey (64) or isabelline (65) KOH-extractable pigments and in having placentiform stromata. ***Daldinia fissa*** usually produces purple pigments in KOH and has turbinate to clavate stromata. Our interpretation of ***D. bakeri*** is quite different from Child's (1932). Child (1932) reported the fungus as having a pithy to fibrous, persistent interior and considered it closely related to ***D. eschscholzii***. However, the lighter concentric zones of the type material are much as those of ***D. fissa***, which are whitish and gelatinous.

Martin (1969) described a hyphomycete with conidiophores of the ***Sporothrix*** type *sensu* P. Martin as the anamorph for ***D. bakeri***. However, his interpretation of ***D. bakeri*** seems to conform with that of Child (1932). We thus suspect that the hyphomycete that he described does not represent the anamorph of our ***D. bakeri***.

Daldinia bambusicola Y.-M. Ju, J. D. Rogers, & San Martín, *sp. nov.*
Figs. 2, 21-23, 74

Etymology: Refers to the bambusicolous habit.

Stromata globosa, sessilia vel subsessilia, levia, 0.6-2 cm diam x 1-1.8 cm alta; externe brunneo-vinosa vel sepiacea, demum denigrata et aliquantum laccata; sub superficie granulis rufobrunneis conspersa, granulis atrolividis vel incoloratis in KOH dissolutis; textura inter perithecia alba vel griseo-brunnea medullosa vel lignea; textura sub peritheciis zonis alternantibus composita, zonis fuscis medullosis vel ligneis, 0.1-0.2 mm crassis et zonis albis vel griseo-brunneis medullosis vel ligneis, persistentibus, 0.5-2 mm crassis praedita. Perithecia obovoidea vel tubularia, 0.3-0.5 mm diam x 0.6-2 mm alta. Ostiola leviter papillata. Asci 140-160 μm longitudine tota x 6-7 μm crassi, partibus sporiferis 45-55 μm longitudine, stipitibus 90-105 μm longitudine, annulo apicali in liquore iodato Melzeri cyanescente, discoideo, 0.3 μm alto x 2 μm lato. Ascosporae brunneae vel fuscae, unicellulares, ellipsoideo-inequilaterales, apicibus angustatis, 8.5-11 x 4-5 µm, rima germinativa recta longa in latere convexo praeditae; perisporium in KOH dehiscens, leve; episporum leve.

Stromata globose, sessile or subsessile, smooth, 0.6-2 cm diam x 1-1.8 cm high; surface brown vinaceous (84) or sepia (63), blackened and somewhat varnished in age; dull reddish brown granules immediately beneath surface, with KOH-extractable pigments dark livid (80) or without apparent KOH-extractable pigments; the tissue between perithecia white to grayish brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.1-0.2 mm thick, the lighter zones white to grayish brown, pithy to woody, persistent, 0.5-2 mm thick. Perithecia obovoid to tubular, 0.3-0.5 mm diam x 0.6-2 mm high. Ostioles slightly papillate. Asci 140-160 µm total length x 6-7 µm broad, the spore-bearing part 45-55 µm long, the stipe 90-105 µm long, with apical ring bluing in Melzer's iodine reagent, discoid, 0.3 µm high x 2 µm broad. Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, 8.5-11 x 4-5 µm, with straight germ slit spore-length on convex side; perispore dehiscent in 10% KOH, smooth; epispore smooth.

Colonies on 2% Difco Oatmeal Agar at ca. 20°C and under 12 h fluorescent light reaching the edge of 9 cm Petri dish in 1-1.5 wk, whitish, felty, azonate, with diffuse margins, with olivaceous buff (89) patches; reverse citrine (13). Sporulating regions scattered over entire surface of colony, whitish. Conidiogenous structure with ***Periconiella***-like branching pattern as defined in Ju and Rogers (1996). Conidiophores mononematous, hyaline to light brown, coarsely roughened, 3.5-5 µm diam, composed of a main axis and sometimes one or more major branches; branches terminating with three to four conidiogenous cells arising in whorls from the main axis and/or from major branches or from additional subordinate branches; additional branches usually lacking or infrequently produced. Conidiogenous cells cylindrical, hyaline, finely roughened to roughened, 10-17 x 2.5-3.5 µm. Conidia produced holoblastically in sympodial sequence. Conidia hyaline, smooth to finely roughened, ellipsoid, with flattened base, 3.5-4.5 x 2.5-3 µm.

SPECIMENS EXAMINED: PHILIPPINES: Manila, II.1909, Merrill, E. D., dead bamboo, as ***Daldinia gollani*** (S); Merrill, E.D. 6326, no substrate data, as ***Daldinia gollani*** (BPI 716949 [Lloyd herb. 12403]). THAILAND: Chiangmai Prov., Doi Inthanon Park, Education Centre, 23.IX.1994, Bandoni, R. J. & A. A., & Flegel, T. W. 10871, bamboo (WSP 69652, HOLOTYPE of ***Daldinia bambusicola***); Nakorn Nayok, near Entrance to Khao Yai, 2.X.1994, Bandoni, R. J. & A. A., & Flegel, T. W. 10991, bamboo (JDR). U.S.A.: Washington, D.C., 12.X.1915, Lyman, G. R., grown at quarantine green house on culm of ***Bambusa*** imported from Manila, Philippines, as ***Daldinia concentrica*** by Lyman, G. R. (BPI 594887).

NOTES: This fungus resembles ***D. clavata*** in having a similar ascospore morphology and in having purplish pigments or apparently lacking KOH-extractable pigments. ***Daldinia bambusicola*** differs from ***D. clavata*** primarily in being associated with bamboos, in having spherical rather than cylindrical stromata, and in having a ***Periconiella***-like conidiogenous structure. Moreover, ***Daldinia bambusicola*** is known to be distributed in southeastern Asia, whereas ***D. clavata*** is known only from the American and African tropics. The smooth stromatal surface and minute ostioles of ***D. bambusicola*** are reminiscent of ***D. eschscholzii*** from which the former differs mainly in having smaller ascospores, in having a different host range, and in having a ***Periconiella***-like conidiogenous structure.

Daldinia brachysperma San Martín, Y.-M. Ju, & J. D. Rogers, *sp. nov.*
Figs. 3, 24, 25

Etymology: Refers to the small ascospores.

Stromata peltata, connectivo medio angustato, levia vel leviter rugosa, 0.7-0.8 cm diam x 0.5 cm alta; externe brunneo-vinosa, sub superficie granulis rufobrunneis conspersa, granulis incoloratis in KOH dissolutis; textura inter perithecia alba vel griseo-brunnea medullosa vel lignea; textura sub peritheciis zonis alternantibus composita, zonis fuscis medullosis vel ligneis, 0.1 mm crassis et zonis albis vel griseo-brunneis medullosis vel ligneis, persistentibus, 0.5 mm crassis praedita. Perithecia obovoidea, 0.3 mm diam x 0.8 mm alta. Ostiola umbilicata. Asci non intacti, annulo apicali in liquore iodato Melzeri cyanescente, discoideo, 0.2 μm alto x 1.5 μm lato. Ascosporae brunneae vel fuscae, unicellulares, ellipsoideo-inequilaterales, apicibus angustatis, 6.5-7.5 x 3-4 μm, rima germinativa recta longa in latere convexo praeditae; perisporium in KOH dehiscens, leve; episporium leve.

Stromata peltate, with narrow central connective, smooth to slightly wrinkled, 0.7-0.8 cm diam x 0.5 cm high; surface brown vinaceous (84); dull reddish brown granules immediately beneath surface, without apparent KOH-extractable pigments; the tissue between perithecia white to grayish brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.1 mm thick, the lighter zones white to grayish brown, pithy to woody, persistent, 0.5 mm thick. Perithecia obovoid, 0.3 mm diam x 0.8 mm high. Ostioles at the same level as stromatal surface. Asci fragmentary, with apical ring bluing in Melzer's iodine reagent, discoid, 0.2 μm high x 1.5 μm broad. Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, 6.5-7.5 x 3-4 μm, with straight germ slit spore-length on convex side; perispore dehiscent in 10% KOH, smooth; epispore smooth.

Anamorph unknown.

SPECIMEN EXAMINED: MEXICO: Quintana Roo state, Othón P. Blanco municipality, Ejido La Unión, 8.XII.1986, San Martín 1376B, wood (ITCV, HOLOTYPE; WSP 69653, ISOTYPE of ***Daldinia brachysperma***).

NOTES: This fungus has the smallest ascospore size in ***Daldinia***.

Daldinia caldariorum Henn., Verh. Bot. Ver. Prov. Brand. 40: 158. 1898.
Figs. 4, 26, 70

= ***Daldinia gollani*** Henn., Hedwigia 40: 339. 1901.
= ***Daldinia cognata*** Har. & Pat., J. Bot. (Morot) 17: 15. 1903.
= ? ***Daldinia corrugata*** Pat. & Har., Bull. Soc. Mycol. France 22: 120. 1906.
= ***Hypoxylon hibisci*** Henn., Hedwigia 47: 259. 1908.
≡ ***Daldinia hibiscus*** (Henn.) C. G. Lloyd, Mycol. Writings 6: 901. 1919.

= ***Daldinia platensis*** Speg., Anales Mus. Nac. Hist. Nat. Buenos Aires 19: 345. 1909.
= ? ***Daldinia aparaphysata*** Saccas, J. Agric. Trop. Bot. Appl. 1: 190. 1954.

Stromata turbinate to depressed-spherical, sessile or with short, stout stipe, solitary to infrequently aggregated, smooth, sometimes with major wrinkles, 0.4-1.8 cm diam x 0.3-1.3 cm high; surface brown vinaceous (84) or grayish sepia (106), blackened and varnished in age; dull reddish brown granules immediately beneath surface, with KOH-extractable pigments livid purple (81), dark livid (80), vinaceous purple (101), or without apparent KOH-extractable pigments; the tissue between perithecia whitish, gray, or brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.1-0.3 mm thick, the lighter zones whitish, gray, or brown, pithy to woody, persistent, 0.3-1 mm thick. Perithecia obovoid, 0.2-0.5 mm diam x 0.5-0.8 mm high. Ostioles obsolete or slightly papillate. Asci 140-155 μm total length x 6-7 μm broad, the spore-bearing part 60-75 μm long, the stipe 60-80 μm long, with apical ring bluing in Melzer's iodine reagent, discoid, 0.5 μm high x 2 μm broad. Ascospores brown to dark brown, unicellular, ellipsoid, slightly inequilateral to equilateral, with broadly to, less frequently, narrowly rounded ends, 8-11 (-12) x 4-5.5 μm, with straight germ slit spore-length usually on less convex side; perispore indehiscent in 10% KOH; epispore smooth.

Colonies on 2% Difco Oatmeal Agar at ca. 20°C and under 12 h fluorescent light reaching the edge of 9 cm Petri dish in 1 wk, whitish, felty, azonate, with diffuse margins, becoming funiculose; reverse uncolored. Stromata confluent, distributed at edge of colony, pulvinate, gray. Sporulating regions at edge of colony, commonly on stromatal surface and less frequently on mycelial surface, hazel (88). Conidiogenous structure with ***Nodulisporium***-like branching pattern as defined in Ju and Rogers (1996). Conidiophores mononematous, di- or trichotomously branched, sometimes with additional branches arising from the first level of conidiogenous regions, hyaline to yellowish, coarsely roughened, 2.5-3 μm diam, with two to three conidiogenous cells arising from each terminus. Conidiogenous cells cylindrical, hyaline, roughened, 10-17 x 2-3 μm. Conidia produced holoblastically in sympodial sequence. Conidia hyaline, smooth, ellipsoid, with flattened base, 4.5-6.5 x 2.8-3.2 μm.

Teleomorph produced in stromata in 6-8 wk, with morphological features as described for naturally-occurring material.

SPECIMENS EXAMINED: ARGENTINA: La Plata, 28.XI.1906, Spegazzini, C., wood (LPS 159, HOLOTYPE of ***Daldinia platensis***). GERMANY: Berlin, Bot. Garden, XI.1885, Sydow, P., wood (S, LECTOTYPE [selected here] of ***Daldinia caldariorum***). MEXICO: Chiapas state, La Trinitaria municipality, Montebello Lagoons, 24.V.1988, San Martín 704 (CULTURED), wood (ITCV; JDR). NEW CALEDONIA: Tendéa, wood (FH, HOLOTYPE; BPI 716961 [Lloyd herb. 12374], ISOTYPE of ***Daldinia cognata***). PHILIPPINES: Merrill, E. D. 4115, wood, as ***Daldinia hibiscus*** by Lloyd, C. G. (BPI 716950 [Lloyd herb. 12408], LECTOTYPE [selected here] of ***Hypoxylon hibisci***). SPAIN: Barra Espagne, 19.XI.1988, Campos, M. F., sent by Candoussau, F. as FC 195, wood (JDR). U.K.: England, Sunderland, Tunstall Hill, 20.XII.1975, Whalley, A. J. S. 369, wood of ***Ulex*** (JDR); Scotland, Edinburgh, VI.1979, Watling, R. & Rogers, J. D., wood of ***Ulex*** (JDR).

NOTES: ***Daldinia caldariorum***, ***D. clavata***, and ***D. eschscholzii*** are the only three species known to produce stromata in culture. ***Daldinia caldariorum*** produced the teleomorph in our cultures. Stromata discharging mature ascospores were produced in 6-8 wk. The germination percentage of discharged ascospores is extremely low. It is noteworthy that ring formation in the stromata did not involve abortive perithecia, as reported by Bayliss-Elliott (1920) (and see earlier herein) for ***D. concentrica***.

Daldinia vernicosa *sensu* Whalley and Watling (1980) is considered to be ***D. caldariorum*** herein. However, it seems possible that the British material represents a distinct taxon based upon its apparent host specificity on burnt ***Ulex*** wood in Great Britain (Whalley and Watling, 1980). The anamorph that they obtained is much as ours except for the conidia being slighter broader, i.e., 4.5-6.5 x 3-4.5 μm vs. 4.5-6.5 x 2.8-3.2 μm.

Hennings (see Saccardo, 1902) originally described this fungus as having small stromata, 6-12 mm broad, with a brown interior, and having small ascospores, 7-10 x 4-4.5 μm, with obtuse ends. Child (1932), after examining the Hennings type at B, redescribed the ascospores as being "inequilaterally ellipsoid to ellipsoid, (9.6)-11.2-(14.4) x 4.8-(6.4) μ". Photographs in Child (1932, Plate 26, Figs. 6 and 7), which were taken from the type material of ***D. caldariorum***, indicate that the ascospores have narrow to acute ends. The discrepancies in these two descriptions seem to have been originated from the Hennings type consisting of two different ***Daldinia*** species. The holotype at B was destroyed during World War II. We examined a duplicate at S and found that it includes materials of ***D. concentrica*** as well as of a ***Daldinia*** that largely fits Hennings' protologue except for having whitish lighter concentric zones. The latter is here selected as the lectotype. We thus infer that Child (1932) took the stromatal features from the material with whitish lighter concentric zones, but the ascospore features from the ***D. concentrica*** material. It should be noted that there is a contradiction in Child's work regarding the color of the stromatal interior. In the key to the species of ***Daldinia***, she keyed out ***D. caldariorum*** from entry seven. This means that she considered the stromatal interior of this fungus to be light and the lighter zones to be "white or some shade of gray". On the other hand, in the description, she wrote that the lighter zones are "Hair Brown". In any case, the lectotype of ***D. caldariorum*** appears to be the same as Child's ***D. gollani***, and Child's ***D. caldariorum*** may have been applied to collections of ***D. eschscholzii*** with whitish lighter concentric zones. Although the type specimen of ***D. gollani*** was not located at S and may not be extant, we believe that ***D. caldariorum*** and ***D. gollani*** are synonymous. Child (1932, Pl. 27, Fig. 7) presented a photograph of ascospores from the type of ***D. gollani*** at B which clearly shows that the ascospores with relatively obtuse ends are typical of ***D. caldariorum***. Furthermore, type materials of ***D. cognata*** and ***Hypoxylon hibisci***, which were listed as synonyms of ***D. gollani*** by Child (1932), are conspecific with ***D. caldariorum***.

Daldinia corrugata was synonymized with ***D. eschscholzii*** by Child (1932). Unfortunately, type material of ***D. corrugata*** was not located. However, it says in the protologue that ***D. corrugata*** has small stromata, 5-10 (rarely 20) mm broad, a white stromatal interior, brown concentric zone lines, and ellipsoid, straight ascospores, 9 x 4 μm. These features strongly point toward ***D. caldariorum*** rather than ***D. eschscholzii***.

We did not see material of ***D. aparaphysata***. The protologue (Saccas, 1954) suggests that it can be placed here. Stromata are subspherical, subsessile, 6-8 mm diam x 5-6 mm high, and have become grayish black on the surface. Perithecia are ovoid to subovoid, 0.35-0.4 mm diam x 0.6-0.8 mm high. Asci have stipes 80-100 μm long. Ascospores are dark brown, ellipsoid, straight or often curved, 8-10 x 4-5.5 μm, with obtuse ends. Nonetheless, the ascospores as shown in the illustrations of Saccas (1954) appear to be strongly inequilateral and have acute ends.

Daldinia clavata Henn., Hedwigia 41: 14. 1902. Figs. 5, 33-35, 71
≡ ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not. *f.* ***clavata*** (Henn.) Theiss., Ann. Mycol. 7: 4. 1909.
= ***Daldinia argentinensis*** Speg., Anales Mus. Nac. Hist. Nat. Buenos Aires 8: 68. 1902.
= ***Daldinia barbata*** Rick, Brotería 5: 50. 1906.
= ***Daldinia argentinensis*** Speg. *var.* ***sessilis*** Speg., Anales Mus. Nac. Hist. Nat. Buenos Aires 19: 345. 1909.
= ***Daldinia albozonata*** C. G. Lloyd, Mycol. Writings 5: 822. 1919.

Stromata cylindrical to somewhat clavate, unbranched or sometimes branched, subsessile or with stout stipe usually bearing constricted rings, solitary to infrequently aggregated, smooth or with inconspicuous to conspicuous perithecial mounds, 1-3.5 cm diam x 1-5.5 cm total length, the stipe up to 2.5 cm long x 0.5-1.5 cm diam; surface brown vinaceous (84), sepia (63), or fuscous (103), blackened and varnished in age; dull reddish brown granules immediately beneath surface, with KOH-extractable pigments dark livid (80), vinaceous gray (116), or without apparent KOH-extractable pigments; the tissue between perithecia whitish, grayish, or brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.2-0.4 mm thick, the lighter zones white to light grayish brown, pithy, becoming fibrous and loosening, 0.7-2 mm thick. Perithecia obovoid, 0.3-0.5 mm diam x 0.6-1 mm high. Ostioles obsolete to slightly papillate. Asci 155-185 μm total length x 6.5-7.5 μm broad, the spore-bearing part 60-75 μm long, the stipe 95-125 μm long, with apical ring bluing in Melzer's iodine reagent, discoid, 0.5 μm high x 2.5-3 μm broad. Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, 8-11.5 x (3.5-) 4-5.5 μm, with straight germ slit spore-length on convex side; perispore dehiscent in 10% KOH, smooth; epispore smooth.

Colonies on 2% Difco Oatmeal Agar at ca. 20°C and under 12 h fluorescent light reaching the edge of 9 cm Petri dish in 1.5 wk, whitish, felty, azonate, with diffuse margins, becoming smoke gray (105) with slight olivaceous tone; reverse uncolored or citrine (13). Stromata sparsely scattered, pulvinate, brown vinaceous (84), remaining sterile. Sporulating regions scattered over entire surfaces of colony and stroma, smoke gray (105). Conidiogenous structure with ***Nodulisporium***-like branching pattern as defined in Ju and Rogers (1996). Conidiophores mononematous, di- or trichotomously branched, sometimes with additional branches arising from the first level of conidiogenous regions, hyaline to yellowish, finely to coarsely roughened, 2.5-3 µm diam, with two to three conidiogenous cells arising from each terminus. Conidiogenous cells cylindrical, hyaline, finely roughened, 10-25 x 2-3 µm. Conidia produced holoblastically in sympodial sequence. Conidia hyaline, smooth to finely roughened, ellipsoid, with flattened base, 4.5-6.5 x 2.5-3 µm.

SPECIMENS EXAMINED: ARGENTINA: Jujuy, Bobadal, Río Pescado, III.1905, Spegazzini, C., wood (LPS 158, LECTOTYPE [selected by Child (1932)] of ***Daldinia argentinensis*** *var.* ***sessilis***); Misiones, Puerto Pampa, I.1901, Kermes, E., wood (LPS 160, HOLOTYPE of ***Daldinia argentinensis***). BRAZIL: St. Catharina, Blumenau, 1892, Möller, A., wood (S, LECTOTYPE [selected here] of ***Daldinia clavata***); Lageado, Rick, J., wood, as ***Daldinia clavata*** by Lloyd, C. G. (BPI 716338 [Lloyd herb. 12393], TYPE of ***Daldinia barbata***). CAMEROON: Zenker, G., wood (BPI 716969 [Lloyd herb. 12375], HOLOTYPE of ***Daldinia albozonata***). GUADELOUPE: XII.1988, Vivant, J., sent by Candoussau, F. as GUAD 418 (CULTURED), wood (JDR). LIBERIA: Ganta, 21.XI.1939, Harley, G. W. 331, wood (JDR). MEXICO: Tamaulipas state, Gómez Farías town, V.1988, Flores 2 & San Martín 1024 (CULTURED), wood (ITCV; JDR).

NOTES: ***Daldinia clavata***, ***D. cuprea***, and ***D. cudonia*** are the only ***Daldinia*** taxa that frequently have a definable stipe supporting the stroma. They differ in the former two taxa having a more robust stromatal stipe and smaller ascospore size ranges. ***Daldinia clavata*** has a geographical distribution in America and western Africa. Child (1932) considered ***D. clavata*** and ***D. albozonata*** to be distinct species. She used the stromatal shape to separate them: the former has clavate stromata, whereas the latter has turbinate or irregularly turbinate stromata. In fact, stromata in the type specimen of ***D. albozonata*** are highly variable, ranging from clavate to turbinate. Using stromatal shape to separate these two species seems therefore unjustified.

Child (1932) used the distribution of perithecia --- whether confined to the upper portion of stroma or covering the entire stroma --- and the conspicuousness of ostioles to differentiate ***D. cuprea*** from ***D. clavata***. We examined the type materials of these two names and found that both of them are definitely stipitate and have their perithecia confined to the upper portion of stromata. Moreover, the ostioles of ***D. cuprea***, in fact, are not more conspicuous than those of ***D. clavata***. To some extent, Child (1932) believed that the stromatal interior of ***D. clavata*** collapses conspicuously and that this could be used to separate ***D. clavata*** from ***D. cuprea***. When an assortment of collections is examined, the lighter concentric zones are seen to be in various stages of disintegration, from pithy to loosely fibrous. Material subjected to heat treatments tends to have more hollow and lighter colored concentric zones. Using different degrees of internal stromatal collapse to separate species is not supported here. However, these two species can be separated by using the conspicuousness of perithecial mounds and stromatal pigments. ***Daldinia clavata*** has a stromatal surface which is smooth or with inconspicuous perithecial mounds and has stromatal pigments that are purplish or lacking in KOH. ***Daldinia cuprea*** has a stromatal surface with very conspicuous perithecial mounds and has dark mouse gray stromatal pigments in KOH.

The cultures and anamorph of ***D. clavata*** highly resemble those of ***D. eschscholzii***. These two fungi are separated primarily by the shape of stromata: the former is cylindrical to somewhat clavate and the latter is turbinate to placentiform. Moreover, ***Daldinia clavata*** is known primarily from Africa and America, whereas ***D. eschscholzii*** has a pantropical distribution.

The type of ***D. argentinensis*** *var.* ***sessilis*** at LPS consists of three fungi which were segregated into three packets by Child (1932, see the footnote on p. 477): ***Daldinia clavata***, ***D. concentrica***, which was labelled as ***D. eschscholzii***, and ***Hypoxylon placentiforme*** Berk. & M. A. Curtis. Child (1932) considered the ***D. clavata*** part as the type, i.e., the lectotype.

Daldinia concentrica (Bolton: Fr.) Ces. & De Not., Comment. Soc. Crittog. Ital. 1: 197. 1863. Figs. 6, 27-29, 72

≡ ***Sphaeria concentrica*** Bolton, Hist. Fung. Halifax III, p. 180. 1789; Bolton: Fr., Syst. Mycol. II, p. 331. 1823; *non* Wahlenberg, 1812.

≡ ***Peripherostoma concentricum*** (Bolton: Fr.) S. F. Gray, Nat. Arr. Brit. Pl. I, p. 513. 1821.

≡ ***Stromatosphaeria concentrica*** (Bolton: Fr.) Grev., Fl. Edinensis, p. 355. 1824.

≡ ***Hypoxylon concentricum*** (Bolton: Fr.) Grev., Scot. Crypt. Fl. VI, Pl. 324. 1828.

≡ ***Hemisphaeria concentrica*** (Bolton: Fr.) Klotzsch, Acad. Caes. Leop. Nova Acta 19: 241. 1843.

= ***Fungus fraxineus***, ***niger***, ***durus***, ***orbiculatus*** J. Ray, Hist. Pl. I, p. 109. 1686. *Fide* Fries (1823), Tulasne and Tulasne (1863), and Child (1932).

= ***Valsa tuberosa*** Scop., Fl. Carniol. II, ed. 2, p. 399. 1772. *Fide* Fries (1823), Tulasne and Tulasne (1863), Miller (1930), and Child (1932).

    ≡ ***Sphaeria tuberosa*** (Scop.) Timm, Fl. Megapol. Prodr., p. 279. 1788.

    ≡ ***Daldinia tuberosa*** (Scop.) J. Schröt., Jahresber. Schles. Ges. Vaterl. Cult. 59: 464. 1881.

    ≡ ***Hypoxylon tuberosum*** (Scop.) Wettst., Verh. K. K. Zool.-Bot. Ges. Wien 35: 591. 1885.

= ***Lycoperdon atrum*** Schaeff., Fungi Bavar. Palat. Nasc. IV, p. 131. 1774. *Fide* Persoon (1801), Fries (1823), Tulasne and Tulasne (1863), and Child (1932).

= ***Lycoperdon fraxineum*** Hudson, Fl. Angl. ed. 2, II, p. 641. 1778. *Fide* Fries (1823) and Child (1932).

= ***Sphaeria tunicata*** Tode, Fung. Mecklenb. Sel. II, p. 59. 1791. *Fide* Persoon (1801), Fries (1823), Tulasne and Tulasne (1863), Miller (1930), and Child (1932).
= ***Sphaeria fraxinea*** Sibth., Fl. Oxon., p. 401. 1794. *Fide* Persoon (1801), Fries (1823), Tulasne and Tulasne (1863), Miller (1930), and Child (1932).
= ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not. *f.* ***confluens*** C. G. Lloyd, Mycol. Writings 5, Large Pyrenomycetes: 24. 1919.
= ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not. *f.* ***intermedia*** C. G. Lloyd, Mycol. Writings 5, Large Pyrenomycetes: 24. 1919.
= ***Hypoxylon simile*** C. G. Lloyd, Mycol. Writings 7: 1282. 1924.
= ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not. *var.* ***minuta*** Waraitch, Indian J. Mycol. Pl. Path. 7: 16. 1977.

Stromata spherical, depressed-spherical to turbinate, sessile or with short, stout stipe, solitary to infrequently aggregated, smooth or with inconspicuous to conspicuous perithecial mounds, 0.5-5 cm diam x 0.8-4 cm high; surface brown vinaceous (84), chestnut (40), or grayish sepia (106), darkened and dull in age; dull orange brown or dull reddish brown granules immediately beneath surface, with KOH-extractable pigments isabelline (65), hazel (88), honey (64), amber (47), or cinnamon (62); the tissue between perithecia brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.2-0.6 mm thick, the lighter zones brown, pithy to woody, persistent, 0.6-1 mm thick. Perithecia tubular, 0.3-0.5 mm diam x 0.7-1.5 mm high. Ostioles slightly papillate. Asci at least 180 μm total length x 8-12 μm broad, the spore-bearing part ca. 90 μm long, the stipe at least 90 μm long, with apical ring bluing in Melzer's iodine reagent, discoid, 0.5 μm high x 3 μm broad. Asci usually fragmentary. Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, 12-16 x 5.5-7.5 μm, with straight germ slit spore-length on convex side; perispore dehiscent in 10% KOH, smooth; epispore smooth.

Colonies on 2% Difco Oatmeal Agar at ca. 20°C and under 12 h fluorescent light reaching the edge of 9 cm Petri dish in 1-1.5 wk, at first whitish, felty, azonate, with diffuse margins, becoming honey (64), sometimes with mouse gray (118) concentric zones, with fulvous (43) exudates; reverse citrine (13) to dull green (70). Sporulating regions scattered over entire surface of colony but with more abundant sporulation on tufts of hyphae at edge of colony, buff (45) to honey (64). Conidiogenous structure with ***Nodulisporium***-like branching pattern as defined in Ju and Rogers (1996). Conidiophores mononematous, di- or trichotomously branched, sometimes with additional branches arising from the first level of conidiogenous regions, hyaline to yellowish, finely roughened, 3-3.5 μm diam, with two to three conidiogenous cells arising from each terminus. Conidiogenous cells cylindrical, hyaline, finely roughened, 10-25 x 3-4 μm. Conidia produced holoblastically in sympodial sequence. Conidia hyaline, smooth to finely roughened, ellipsoid, with flattened base, 7-9 (-10.5) x 4.5-5.5 μm.

SPECIMENS EXAMINED: FRANCE: Bois de la Barthe, 64 Pomarez, Près Tartas, IX.1985, Gilles, G., (CULTURED), wood of ***Alnus*** (JDR); Mauléou, Vallée d'Aspe, 8.IX.1985, Candoussau, F., wood of ***Corylus*** (JDR);

Forêt Bangugue, VIII.1990, Rogers, J. D., (CULTURED), wood (JDR); Tartas, VIII.1990, Rogers, J. D., (CULTURED), wood (JDR). INDIA: Glen, Simla, Himachal Pradesh, 28.VII.1965, Waraitch, K. S. 2607, bark of oak, as ***Daldinia concentrica*** (BPI 594922, ISOTYPE of ***Daldinia concentrica** var.* ***minuta***); Imphal, Ukhrul, 29.VIII.1978, Narula, A. M. 293, dead twig (JDR). MEXICO: Tamaulipas state, Gómez Farías municipality, Ejido Julilo, 1.XI.1987, Chacón 51, wood (ITCV; JDR); Tamaulipas state, Gómez Farías municipality, Ejido Alta Cima, 1.XII.1987, Chacón 346; 12.VIII.1988, Chacón 439; 18.IX.1985, José Castillo 526, wood (ITCV; JDR); Tamaulipas state, EL Cielo Ranch, 22.VII.1988, Chacón 369, wood (ITCV; JDR); Tamaulipas state, Gómez Farías town, 12.VIII.1988, Chacón 434, wood (ITCV; JDR); Tamaulipas state, "Malacate", 13.VIII.1988, Chacón 457, wood (ITCV; JDR); Tamaulipas state, Hidalgo municipality, Ejido Conrado Castillo, VII.1988, Lucrecia García 123 (CULTURED) & 122, wood (ITCV; JDR). NEW ZEALAND: Christchurch, Mitchell, J., wood (BPI 11354, HOLOTYPE of ***Hypoxylon simile***). TAIWAN: Tai-nan Co., Yon-kong, 5.IV.1984, Hsieh, H.-M. 73040501, wood (JDR; NTU); Nan-tou Co., Lu-ku, Sun-linn-shi, 27.VII.1984, Ju, Y.-M. 73072706, wood (JDR; NTU); Taipei City, campus of National Taiwan Univ., 8.XI.1987, Ju, Y.-M. 76110810, wood (JDR; NTU). U.S.A.: Hawaii Islands, Kauai, Kokee Park, 9.I.1996, Rogers, J. D., (CULTURED), wood of ***Acacia koa*** (JDR); Idaho, Priest River, Weir, J. R., wood of ***Alnus***, as ***Daldinia confluens*** C. G. Lloyd, *ined.* (BPI 716987 [Lloyd herb. 12379], HOLOTYPE of ***Daldinia concentrica** f.* ***confluens***); Indiana, McCormick Creek State Park, 16.VIII.1981, Rogers, J. D., wood (JDR); Michigan, Calhoun Co., Albion, 25.VIII.1960, Stowell, E. A., branches of ***Prunus cerasus*** (JDR); Minnesota, Itasca, VIII.1973, Rogers, J. D., wood (JDR); New Hampshire, Ellsworth, 14.IX.1937, wood of ***Alnus***, as ***Daldinia simulans*** (BPI 594606); Wisconsin, Cleveland, Goessel, C., wood, as ***Daldinia intermedia*** C. G. Lloyd, *ined.* (BPI 716996 [Lloyd herb. 12405], SYNTYPE of ***Daldinia concentrica** f.* ***intermedia***). LOCALITY UNKNOWN: wood, as ***Sphaeria concentrica*** Bolton (L 910, 270-380 [Persoon herb. 184]); wood, as ***Sphaeria concentrica*** "Tode" & ***Sphaeria fraxinea*** Sibth. (L 910, 270-370 [Persoon herb. 271]).

NOTES: ***Daldinia concentrica*** is the type species of the genus. Most of the early collections of ***Daldinia***, e.g., Persoon's, regardless of their real identities, have been identified as this species. Because Bolton's original material is lacking, we accept Bolton's original illustrations on plate 180 (Bolton, 1789; see also Whalley and Watling, 1980, for a reprint of this plate) as the holotype and interpret this fungus in accordance with the current concept, e.g., Miller (1930, 1942), Child (1932), Martin (1969), Whalley and Watling (1980), Petrini and Müller (1986), San Martín (1992), and Van der Gucht (1993, 1994). ***Daldinia eschscholzii*** is generally considered to be easily confused with ***D. concentrica***. They can be readily separated by the stromatal pigments extracted by KOH: the former has purplish pigments or lacks apparent pigments, whereas the latter has yellowish, greenish, or olivaceous pigments. Their anamorphic and cultural characters are also different. See NOTES on ***D. eschscholzii*** for further comparison.

The anamorph of *D*. ***concentrica*** has been described a number of times (see Table 1). Molliard (1904) proposed the name ***Nodulisporium tulasnei*** Molliard for it. Its conidiogenous structure has a ***Nodulisporium***-like branching pattern as defined in Ju and Rogers (1996). However, the conidial dimensions given by different mycologists vary somewhat (see Table 1). The different substrates or media from which conidia were described may influence conidial dimensions. Many collections identified as ***D. concentrica***, in fact, are not this fungus; thus, it is also probable that the variation in reported conidial dimensions is owing to the involvement of several taxa.

There is a curious report of ***D. concentrica*** from Poaceae (Farr et al., 1989). The specimen forming the basis for this report is ***D. bambusicola*** on alien quarantined bamboo (see SPECIMENS EXAMINED of ***D. bambusicola***).

Daldinia cudonia (Berk. & M. A. Curtis) C. G. Lloyd, Mycol. Writings 7: 1255. 1924. Figs. 7, 38, 39

≡ ***Xylaria cudonia*** Berk. & M. A. Curtis *apud* Berk., Grevillea 4: 47. 1875.

= ***Daldinia murrillii*** C. G. Lloyd, Mycol. Writings 6: 901. 1919.

Stromata turbinate to clavate, unbranched, with slender stipe bearing constricted rings, smooth, 0.7-1.5 cm diam x 1-2.3 cm total length, the stipe

Table 1. Reported conidial dimensions from ***Daldinia concentrica***.

Author(s)	**Conidial size range**
Tulasne and Tulasne (1863)	6.5-8 x 5-6.5 μm
Jaczewski (1895)	6.5-8 x 5-6.5 μm
Molliard (1904)	7-8 x 4.5-5.4 μm
Brooks (1913)	6-8 x 3-4 μm
Bayliss-Elliott (1920)	6.5-8 x 5-6 μm
Miller (1928, 1930)	6-8 x 4-5 μm
Greenhalgh and Chesters (1968)	5-8.5 x 3-4.5 μm
Martin (1969)	4.3-8.7 x 3.7-5 μm (ave. 6.3 x 4.1 μm)
Jong (1970)	5-10 x 3-4 μm
Whalley and Watling (1980)	4.5-8.5 x 3.5-5 μm
Petrini and Müller (1986)	6-8 x 4-5 μm
Van der Gucht (1994)	(6-) 6.5-8.5 (-9) x 3-4 μm
present study	7-9 (-10.5) x 4.5-5.5 μm

0.5-1.5 cm long x 1.5-3.5 mm diam; surface brown vinaceous (84) or dark brick (60), blackened and varnished in age; dull reddish brown granules immediately beneath surface, with KOH-extractable pigments dilute purple or without apparent KOH-extractable pigments; the tissue between perithecia brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.2 mm thick, the lighter zones grayish brown to brown, pithy to woody, sometimes with locules, persistent, 0.3-1.5 mm thick close to the perithecial layer, up to 3.5 mm thick in the stipe. Perithecia tubular, 0.3-0.4 mm diam x 1-1.3 mm high. Ostioles obsolete to slightly papillate. Asci 200-280 µm total length x 10-12 µm broad, the spore-bearing part 80-100 µm long, the stipe 120-180 µm long, with apical ring bluing in Melzer's iodine reagent, discoid, 0.5 µm high x 3 µm broad. Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, 12.5-16.5 (-19.5) x 6-8 µm, with straight to slightly oblique germ slit spore-length on convex side; perispore dehiscent in 10% KOH, smooth; epispore smooth.

Anamorph unknown.

SPECIMENS EXAMINED: MEXICO: Murrill, W. A., wood (BPI 717012 [Lloyd herb. 12402], HOLOTYPE of ***Daldinia murrillii***); Veracruz, Município de San Andrés, Atilpan, Ventura, F. 11560, wood (JDR); Veracruz state, Jalapa City, 31.VIII.1986, García 5267; 14.VIII.1987, San Martín 1111B, 1113B, and 1422B, wood (ITCV; JDR). U.S.A.: South Carolina, Santee Canal, Curtis, M. A., dead tree (K, HOLOTYPE of ***Xylaria cudonia***).

NOTES: ***Daldinia cudonia*** is characterized by having a slender stromatal stipe less than 5 mm diam. It is given as ***D. loculata*** in Child (1932). See NOTES on ***D. loculata*** for further discussion.

Daldinia cuprea Starb., Bih. Kongl. Svenska Vetensk.-Akad. Handl. 27, 3: 5. 1901. Figs. 8, 36, 37

= ***Daldinia granulosa*** Speg., Anales Mus. Nac. Hist. Nat. Buenos Aires 19: 345. 1909.

Stromata cylindrical, unbranched, subsessile or with stout stipe usually bearing constricted rings, solitary, with conspicuous perithecial mounds, 1-2 cm diam x up to 5.5 cm total length, the stipe up to 2 cm long x 0.7-1.3 cm diam; surface fuscous (103), blackened and varnished in age; dull reddish brown granules immediately beneath surface, with KOH-extractable pigments dark mouse gray (119); the tissue between perithecia whitish, grayish, or brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.2-0.3 mm thick, the lighter zones white, pithy, becoming fibrous and loosening, 2-3 mm thick. Perithecia obovoid, 0.4-0.6 mm diam x 0.6-0.8 mm high. Ostioles slightly papillate. Asci fragmentary, with apical ring bluing in Melzer's iodine reagent, discoid, 0.5 µm high x 2.5 µm broad. Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, 10-11.5 x 4.5-5.5 µm, with straight germ slit spore-length on convex side; perispore dehiscent in 10% KOH, smooth; epispore smooth.

SPECIMENS EXAMINED: ARGENTINA: Jujuy, Bobadal, Río Pescado, III.1905, Spegazzini, C., wood (LPS 157, HOLOTYPE of ***Daldinia***

granulosa). PARAGUAY: Paraguari, Cerro Negro, 8.VIII.1893, Malme, G. A., wood (S [2 pks.], HOLOTYPE of ***Daldinia cuprea***).

NOTES: This fungus is known only from South America. ***Daldinia cuprea*** and ***D. clavata*** are very similar but differ in the former having very conspicuous perithecial mounds and having dark mouse gray pigments. Also see NOTES on ***D. clavata*** for comparison.

Daldinia eschscholzii (Ehrenb.: Fr.) Rehm, Ann. Mycol. 2: 175. 1904.
Figs. 9, 30-32, 73
≡ ***Sphaeria eschscholzii*** Ehrenb.: Fr., Fung. Chamisso Coll., pl. 18, fig. 8. 1820.
≡ ***Sphaeria concentrica*** Bolton: Fr. *var.* ***eschscholzii*** (Ehrenb.: Fr.) Fr., Syst. Mycol. II, p. 331. 1823.
≡ ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not. *var.* ***eschscholzii*** (Ehrenb.: Fr.) Starb., Bih. Kongl. Svenska Vetensk.-Akad. Handl. 27, 3: 5. 1901.
= ***Hypoxylon stratosum*** Sacc., Syll. Fung. IX, p. 544. 1891.
≡ ***Daldinia stratosa*** (Sacc.) Sacc. & Trott., Syll. Fung. XXII, p. 327. 1913.
= ***Daldinia luzonensis*** Rehm, Philipp. J. Sci., Bot. 8: 260. 1913.

Stromata turbinate to placentiform, sessile or with short, stout stipe, solitary to infrequently aggregated, smooth, 1.5-6 cm diam x 1-4 cm high; surface brown vinaceous (84), dark brick (60), sepia (63), grayish sepia (106), or vinaceous gray (116), blackened and varnished in age; dull reddish brown granules immediately beneath surface, with KOH-extractable pigments livid purple (81), dark livid (80), or vinaceous purple (101), or without apparent KOH-extractable pigments; the tissue between perithecia brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.2-0.4 mm thick, the lighter zones white, gray, or grayish brown, gelatinous and very hard when dry, becoming pithy to woody, persistent, 0.4-1 mm thick. Perithecia tubular, 0.3-0.4 mm diam x 1-1.5 mm high. Ostioles obsolete or slightly papillate. Asci 160-195 μm total length x 7-9 μm broad, the spore-bearing part 70-80 μm long, the stipe 90-120 μm long, with apical ring bluing in Melzer's iodine reagent, discoid, 0.5 μm high x 2-2.5 μm broad. Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, 10-14 (-15.5) x 5-6.5 μm, with straight germ slit spore-length on convex side; perispore dehiscent in 10% KOH, smooth; epispore smooth.

Colonies on 2% Difco Oatmeal Agar at ca. 20°C and under 12 h fluorescent light reaching the edge of 9 cm Petri dish in 1-1.5 wk, whitish, felty, azonate, with diffuse margins, becoming smoke gray (105) with slight olivaceous tone; reverse uncolored, citrine (13), or dull green (70). Stromata sparse, scattered, pulvinate, brown vinaceous (84), remaining sterile. Sporulating regions scattered over entire surfaces of colony and stroma, smoke gray (105). Conidiogenous structure with ***Nodulisporium***-like branching pattern as defined in Ju and Rogers (1996). Conidiophores mononematous or sometimes synnematous, di- or trichotomously branched, sometimes with additional branches arising from the first level of conidiogenous regions, hyaline to yellowish, finely to coarsely roughened, 2.5-3 μm diam, with two to three conidiogenous cells arising from each terminus. Conidiogenous cells cylindrical, hyaline, finely roughened, 8-22 x 2-3 μm. Conidia produced holoblastically in sympodial sequence. Conidia hyaline, smooth to finely roughened, ellipsoid, with flattened base, 4.5-6.5 x 2.5-3 μm.

SPECIMENS EXAMINED: AUSTRALIA: Gracemere, O'Shenesy, wood (PAD, HOLOTYPE of ***Hypoxylon stratosum***). BRAZIL: Pará Belem, Ilhado do Comba, Estasao, I.1989, Samuels, G. J. 6227, wood (JDR); Pará, Lageira, airstrip on Rio Maicuru, 19.VII.1981, Strudwick, J. J. & Sobel, G. L. 3198, wood (JDR; NY). GUADELOUPE: Monts Caraibes Basse Terre, XII.1988, Vivant, J., sent by Candoussau, F. as GUAD 405 (CULTURED), wood (JDR). INDIA: Assam, Haflong, 23.VII.1978, Narula, A. M. 219, log (JDR). INDONESIA: North Sulawesi, Dumoga-Bone National Park, IX-X.1985, Samuels, G. J. 1939 & 2357A, log (JDR). MEXICO: Oaxaca, Temascal, 6.VIII.1976, Guzmán, G. 16304, wood (JDR); Oaxaca, Temascal, Mojica, O., wood (JDR); Lopez, A. 495, wood (JDR); Quintana Roo state, Othón P. Blanco municipality, San Felipe Bacalar, 10.XI.1988, San Martín 1196 & 1229, wood (ITCV; JDR); Quintana Roo state, Sian Ka'an Biosphere Reserve, 15.XI.1988, San Martín 1267, wood (ITCV; JDR); Campeche state, Escárcega municipality, "Ing. Eduardo Sangri Serrano" Forestry Experimental Station, 9.XI.1988, San Martín 1192A, wood (ITCV; JDR); Oaxaca state, Temazcal town, 8.X.1988, San Martín 1135, wood (ITCV; JDR); Quintana Roo state, José María Morelos municipality, Carolina, 7.II.1986, Guevara s/n; San Carlos, 7.XI.1986, Guevara s/n and Guevara 701A; X-Cabil, 11.I.1986, Guevara s/n, San Miguel Ranch, 12.I.1986, Guevara s/n, wood (ITCV; JDR); Quintana Roo state, Othón P. Blanco municipality, Ejido La Unión, 8.XII.1986, San Martín 422A; 12.XI.1988, San Martín 1299, wood (ITCV; JDR); Tamaulipas state, Gómez Farías town, 10.IX.1985, Cázares 273; 14.X.1986, San Martín 23, 31; 1987, San Martín 631; 20.IX.1988, San Martín 1027 & 1046, wood (ITCV; JDR); Tamaulipas state, Gómez Farías municipality, Ejido Julilo, XI.1987, San Martín 949, wood (ITCV; JDR); Tamaulipas state, Ocampo municipality, Colonia Santa María Ocampo, X.1987, San Martín 456; 16.V.1988, San Martín 655, wood (ITCV; JDR). PHILIPPINES: Luzon, Laguna Prov., Los Baños, Baker, C. F. 516, comm. via Merrill, E. D., wood (BPI, 716999 [Lloyd herb. 12401], LECTOTYPE [selected here] of ***Daldinia luzonensis***). SINGAPORE: VII.1974, Jaquenoud, M., sent by Candoussau, F., wood (JDR). TAIWAN: Taipei City, Da-tung-shan, V.1985, Ju, Y.-M. 74050001, wood (JDR). THAILAND: Bangkok, Rathwithi Rd., Khao Din, 31.X.1993, Bandoni, R. J. & A. A. 10223, wood (JDR); Soratthani Prov., Khao Sok, 1.IX.1993, Bandoni, R. J. & A. A. 9880 (CULTURED), dead rubber tree (JDR). U.S.A.: Texas, near Sinton, Welder Wildlife Refuge, 1-2.XII.1973, Lawrence, J. F. 3533 (CULTURED), wood (JDR).

NOTES: This fungus was originally reported from the Philippines. It has long been questioned as to whether or not ***D. eschscholzii*** and ***D. concentrica*** are separable. Fries (1823) reduced it to a variety of the latter as ***Sphaeria concentrica*** Bolton: Fr. *var.* ***eschscholzii*** (Ehrenb.: Fr.) Fr.

Dennis (1963) reviewed the history of this fungus and, following Sprengel, Starbäck, and Rehm, accepted it as a variety of ***D. concentrica***. Dennis (1963, 1974) also remarked that this fungus is a tropical analogue of ***D. concentrica***. This was also followed by Thind and Dargan (1978). On the other hand, most mycologists, e.g., Miller (1930, 1942), Child (1932), Martin (1969), Petrini and Müller (1986), Rogers et al. (1987), San Martín (1992), Van der Gucht (1993, 1994), considered ***D. eschscholzii*** as a species. In our opinion, ***Daldinia eschscholzii*** and ***D. concentrica*** can be readily and reliably separated by the KOH-extractable stromatal pigments. ***Daldinia eschscholzii*** yields purplish pigments, which vary from dense to dilute, or, particularly in aged and depauperate specimens, does not yield apparent pigments. ***Daldinia concentrica*** yields pigments that vary from yellowish, greenish, to olivaceous; they are inevitably present. In addition, several other characters are of diagnostic value in separating ***D. eschscholzii*** from ***D. concentrica***. ***Daldinia eschscholzii*** has a smooth stromatal surface which becomes black and varnished when aged. ***Daldinia concentrica*** tends to commonly have perithecial mounds on the stromatal surface which darkens but does not become varnished in age. ***Daldinia eschscholzii*** tends to have a more flattened stromatal top and slightly smaller ascospores than ***D. concentrica***. Van der Gucht (1993) reported that by SEM the ascospore perispore of ***D. eschscholzii*** is ornamented with coil-like ornamentation, but that of ***D. concentrica*** is almost smooth. In culture, ***Daldinia eschscholzii*** produces smaller conidia, 4.5-6.5 x 2.5-3 μm vs. 7-9 (-10.5) x 4.5-5.5 μm, and less robust conidiophores than ***D. concentrica***. Moreover, the sporulating regions of ***D. eschscholzii*** are gray, but those of ***D. concentrica*** are ochraceous. Van der Gucht (1994) compared cultures of these two fungi on malt extract agar. In general, her data on microscopic features of these two fungi agree with ours except that the conidial size that she gave for ***D. concentrica***, (6-) 6.5-8.5 (-9) x 3-4 μm, is slightly smaller than reported herein.

In addition to having persistent, pithy to woody tissue in the lighter concentric zones, younger stromata of ***D. eschscholzii*** also contain gelatinous tissue which, when dry, has a very hard consistency. This gelatinous tissue disappears with age and sometimes leaves locules in the persistent tissue. This phenomenon also occurs in ***D. grandis*** and is believed to occur in ***D. loculata*** whose mature and overmature stromata frequently have locules in the lighter concentric zones. Further collections may show that other species have this phenomenon as well.

No type material of ***D. luzonensis*** was located at the Rehm herbarium of S. The BPI element is therefore selected as the lectotype.

Daldinia fissa C. G. Lloyd, Mycol. Writings 7: 1313. 1924.

Figs. 10, 40-43

= ***Sphaeria concentrica*** Bolton: Fr. *var.* ***pedicellata*** Pers., Syn. Meth. Fung. I, p. 8. 1801; [*nom. rejic.*, ICBN Art. 13.1(d)].

≡ ***Sphaeria concentrica*** Bolton: Fr. var. ***obovata*** Fr.: Fr., Syst. Mycol. II, 331. 1823.

≡ ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not. *var.* ***obovata*** (Fr.: Fr.) Sacc., Syll. Fung. I, p. 394. 1882.

= ***Sphaeria vernicosa*** Schwein., J. Acad. Nat. Sci. Philadelphia 5: 9. 1825; *non* DC. & Lam. [: Fr.], 1815; *nec* Fée, 1834; [*nom. rejic.*, ICBN Arts. 13.1(d) & 64.1].

≡ ***Daldinia vernicosa*** (Schwein.) Ces. & De Not., Comment. Soc. Crittog. Ital. 1: 198. 1863.

≡ ***Hypoxylon vernicosum*** (Schwein.) Berk. & M. A. Curtis *apud* Berk., J. Linn. Soc., Bot. 10: 384. 1869; *non* Ellis & Everh., 1897.

= ***Daldinia simulans*** Child, Ann. Missouri Bot. Gard. 19: 453. 1932.

Stromata turbinate or peltate, usually stipitate, solitary or aggregated, smooth or wrinkled, lacking perithecial mounds, 0.5-4 cm diam x 0.5-3.8 cm high; surface brown vinaceous (84), blackened and varnished in age; dull reddish brown granules immediately beneath surface, with KOH-extractable pigments dark livid (80) or livid violet (79); the tissue between perithecia grayish brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.1-0.2 mm thick, the lighter zones white, gelatinous, disintegrating and becoming loculate when dry, 0.6-1.3 mm thick. Perithecia tubular, 0.3-0.4 mm diam x 0.8-1.3 mm high. Ostioles slightly papillate. Asci fragmentary, with apical ring bluing in Melzer's iodine reagent, discoid, 0.5 μm high x 3-3.5 μm broad. Ascospores dark brown to blackish brown, unicellular, ellipsoid, slightly inequilateral to equilateral, with broadly to narrowly rounded ends, 11.5-15.5 x 6.5-9 μm, with straight germ slit spore-length on more convex side; perispore indehiscent or, infrequently, dehiscent in 10% KOH; epispore smooth.

The anamorph has been described by Martin (1969) [as ***D. vernicosa***] on 2% malt agar.

SPECIMENS EXAMINED: INDIA: Imphal, Ukhrul, 29.VIII.1978, Narula, A. M. 294, dead twig (JDR). MEXICO: Chiapas state, La Trinitaria municipality, Montebello Lagoons, 24.V.1988, San Martín 704B, wood (ITCV; JDR). U.S.A.: Arizona, Santa Cruz Co., Coronado National Forest, Sycamore Canyon, 30.IX.1967, Gilbertson, R. L. 7344, wood of ***Platanus wrightii*** (JDR); Missouri, Valley Park, IX.1929, Linder, D. H., decaying post (FH, HOLOTYPE of ***Daldinia simulans***); New Jersey, Newfield, IX.1894, Ellis & Everhart's Fungi Columbiani 735, dead white oak saplings, as ***Daldinia vernicosa*** (WSP 1782); North Carolina, Salem, Syn. 1175, wood (PH, HOLOTYPE of ***Sphaeria vernicosa***); Ohio, Toledo, Lowater, W. R., wood (BPI 716013 [Lloyd herb. 12382], HOLOTYPE of ***Daldinia fissa***).

NOTES: This fungus is better known as ***D. vernicosa*** (Schwein.) Ces. & De Not. Unfortunately, this name is unavailable for this fungus because its basionym, ***Sphaeria vernicosa*** Schwein., is a later homonym of ***S. vernicosa*** DC. & Lam.: Fr.

We did not obtain cultures from this fungus. Martin (1969) reported that the conidiophores are of the simple ***Sporothrix*** or ***Nodulisporium*** type which roughly correspond to the ***Virgariella***-like branching pattern as defined in Ju and Rogers (1996). Martin (1969) gave the conidial size 5.6-8.8 x 3.7-4.3 µm (6.9 x 4.1 µm in average).

Child (1932) stated that "From the early descriptions and illustrations, ***H. concentricum*** *var.* ***obovatum*** is clearly synonymous with ***D. vernicosa***, ...". Fries (1823), in fact, erected *var.* ***obovata*** for ***Sphaeria concentrica*** rather than ***Hypoxylon concentricum***. Meanwhile, he referred it to Persoon's *Synopsis Methodica Fungorum* I, Pl. 1, Fig. 3 and 4, and Nees' *Das System der Pilze und Schwämme*, Fig. 308. Child (1932) also considered Persoon's ***Sphaeria concentrica*** *var.* "***stipitata***" a synonym of ***D. vernicosa***. She gave the citation as "Syn. Meth. Fung. 1: 8. pl. 1. figs 3-4". However, Persoon (1801, p. 8) did not create a *var.* ***stipitata*** but *var.* ***pedicellata***. Interestingly, Persoon (1801), in the *EXPLICATIO ICONUM*, gave a legend to the illustrations of his stipitate variety of ***Sphaeria concentrica*** and happened to phrase it as "***Sphaeria concentrica***, var. stipitata". This may have led Child (1932) to consider that Persoon had introduced a new variety, ***stipitata***. Despite these minor disagreements with Child's citations, we agree with her in the synonymy of ***S. concentrica*** *var.* ***obovata***, ***D. vernicosa***, and ***D. fissa***. Owing to Fries (1823) referring his *var.* ***obovata*** to Persoon's figures, it is reasonable to consider this variety a nomenclatural synonym of Persoon's *var.* ***pedicellata***. Nees (1817) merely copied Persoon's figures and referred to Persoon's *Synopsis* without giving much further account.

Child (1932) mentioned that ***D. simulans*** differs from ***D. vernicosa*** in usually having smaller stromata, in having a brownish rather than a purplish stromatal surface which is somewhat transversely rugose in young material, and in having a stipe which is "more conspicuously annulate from the internal concentric zones". Child (1932) also remarked that ***D. simulans*** is physiologically distinct from ***D. vernicosa***. It appears that the morphological characters used by Child to separate these two putative ***Daldinia*** species are rather variable and thus not definitive in separating two species.

The type specimen of ***Versiomyces cahuchucosus*** Whalley & Watling [AUSTRALIA: Queensland, Boobara National Park, Watling, R. 10838, wood of ***Eucalyptus*** (E, HOLOTYPE)] is more or less depauperate. No asci were observed. Its morphology is in general in agreement with ***D. fissa***. Although Child (1932) considered ***D. fissa*** to be cosmopolitan, as far as we know, this fungus is represented mostly by collections from the Northern Hemisphere, mainly North America and Eurasia. We suspect that ***V. cahuchucosus*** and ***D. fissa*** are synonyms, but withhold a final decision until better specimens are available.

Daldinia gelatinosa Y.-M. Ju, J. D. Rogers, & San Martín, *sp. nov.*
Figs. 11, 44-46

Etymology: Refers to the gelatinous nature of the lighter concentric zones.

Stromata turbinata vel cylindrica, sessilia vel brevia stipitata, solitaria vel aggregata, rugosa, sine tumulis peritheciorum, 0.7-3.5 cm diam x 1-3 cm alta; externe latericia, demum denigrata et laccata; sub superficie granulis rufobrunneis conspersa, granulis atrolividis vel incoloratis in KOH dissolutis; textura inter perithecia griseo-brunnea medullosa vel lignea; textura sub peritheciis zonis alternantibus composita, zonis fuscis medullosis vel ligneis, 0.3-0.7 mm crassis et zonis albis, gelatinosis, fatiscentibus et loculatis in sicco, 0.7-1.5 mm crassis praedita. Perithecia tubularia, 0.3-0.4 mm diam x 0.8-1.2 mm alta. Ostiola leviter papillata vel papillata. Asci 195-250 µm longitudine tota x 8-10 µm crassi, partibus sporiferis 80-90 µm longitudine, stipitibus 110-160 µm longitudine, annulo apicali in liquore iodato Melzeri cyanescente, discoideo, 1 µm alto x 3.5-4 µm lato. Ascosporae brunneae vel fuscae, unicellulares, ellipsoideo-inequilaterales, apicibus angustatis, 12.5-15.5 x 6-7.5 µm, rima germinativa recta longa in latere convexo praeditae; perisporium in KOH dehiscens, leve; episporium leve.

Stromata turbinate or cylindrical, sessile or short stipitate, solitary or aggregated, wrinkled, lacking perithecial mounds, 0.7-3.5 cm diam x 1-3 cm high; surface dark brick (60), blackened and varnished in age; dull reddish brown granules immediately beneath surface, with KOH-extractable pigments dark livid (80) or without apparent KOH-extractable pigments; the tissue between perithecia grayish brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.3-0.7 mm thick, the lighter zones white, gelatinous, disintegrating and becoming loculate when dry, 0.7-1.5 mm thick. Perithecia tubular, 0.3-0.4 mm diam x 0.8-1.2 mm high. Ostioles slightly papillate to papillate. Asci 195-250 µm total length x 8-10 µm broad, the spore-bearing part 80-90 µm long, the stipe 110-160 µm long, with apical ring bluing in Melzer's iodine reagent, discoid, 1 µm high x 3.5-4 µm broad. Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, 12.5-15.5 x 6-7.5 µm, with straight germ slit spore-length on convex side; perispore dehiscent in 10% KOH, smooth; epispore smooth.

Anamorph unknown.

SPECIMENS EXAMINED: CANADA: Ontario, London, VII.1904, Dearness, J., Fungi Columbiani 2013, wood, as ***Daldinia concentrica*** (WSP 1781), mixed with an immature ***Daldinia***. U.S.A.: Idaho, Valley Co., Head of Split Cr., 18.VIII.1964, Kistler, L., wood, as ***Daldinia concentrica*** (WSP 54679); Idaho, Valley Co., Snowslide Lake, 18.VIII.1964, Harrison, K., wood, as ***Daldinia concentrica*** (WSP 54729); New Hampshire, Waterville, 9.VIII.1967, Rogers, J. D., wood of ***Betula alleghaniensis*** (WSP 69649, HOLOTYPE of ***Daldinia gelatinosa***).

NOTES: This fungus is similar to ***D. fissa*** in having KOH-extractable pigments purplish or lacking apparent pigments and in having gelatinous, whitish lighter zones in the stromata. Although they have similar ascospore size ranges, their ascospore shape is different. ***Daldinia gelatinosa*** has strongly inequilateral ascospores, whereas ***D. fissa*** has slightly inequilateral to equilateral ascospores. Moreover, the ascospore perispore of ***D. gelatinosa*** is always dehiscent in KOH; that of ***D. fissa*** is only infrequently dehiscent in KOH. ***Daldinia gelatinosa*** and ***D. mexicana*** appear to be closely related. They differ mainly in the stromatal pigments extracted with KOH. It also greatly resembles ***D. concentrica*** from which it is most easily separable on KOH-extractable pigments.

Daldinia graminis Dargan & Thind, Kavaka 12: 115. 1984.

Figs. 65-68

Stromata turbinate, sessile or with narrow connective, solitary to infrequently aggregated, with inconspicuous perithecial mounds, 5-7 mm diam x 4-5 mm high; surface sepia (63) or brown vinaceous (84); dull reddish brown granules immediately beneath surface, without apparent KOH-extractable pigments; the tissue between perithecia whitish or gray, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.2 mm thick, the lighter zones whitish or gray, pithy to woody, persistent, 0.4-0.8 mm thick. Perithecia obovoid, 0.3 mm diam x 0.7 mm high. Ostioles at the same level as the stromatal surface. Asci with ascospores arranged partially biseriately, 190-215 μm total length x 16-19 μm broad, the spore-bearing part 95-110 μm long, the stipe 90-110 μm long, with apical ring bluing in Melzer's iodine reagent, discoid, 1 μm high x 4-4.5 μm broad. Ascospores brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, 20-26 (-30) x 7.5-9 μm, with straight germ slit much less than spore-length on convex side; perispore indehiscent in 10% KOH; epispore smooth.

Anamorph unknown.

SPECIMEN EXAMINED: INDIA: Union Territory, Chandigarh, 20.VIII.1966, Chahal, H. S. 69,on burnt stems of ***Saccharum*** (K 36396, ISOTYPE of ***Daldinia graminis***).

NOTES: This fungus is characterized by small stromata, large ascospores with a much less than spore-length germ slit, and whitish lighter concentric zones in the stromata. The ascospore dimension given by Dargan and Thind (1984) is 16.8-22.5 x 7.2-8 (-9.6) μm, somewhat smaller than that given herein.

Daldinia grandis Child, Ann. Missouri Bot. Gard. 19: 456. 1932.

Figs. 12, 49, 50, 75

= ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not. *f.* ***californica*** C. G. Lloyd, Mycol. Writings 5, Large Pyrenomycetes: 23. 1919.

Stromata depressed-spherical to hemispherical, sessile or nearly so, solitary, infrequently aggregated or confluent, with inconspicuous to conspicuous perithecial mounds, 2.5-8 cm diam x 1.5-5.5 cm high; surface brown vinaceous (84), blackened and varnished in age; dull reddish brown granules immediately beneath surface, with KOH-extractable pigments livid purple (81), dark livid (80), or without apparent KOH-extractable pigments; the tissue between perithecia brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.3-0.8 mm thick, the lighter zones gray, grayish brown to brown, gelatinous when fresh but very hard when dry, becoming pithy to woody, sometimes with locules, persistent, 0.8-2 mm thick. Perithecia tubular, 0.3-0.5 mm diam x 0.8-1.5 mm high. Ostioles slightly papillate. Asci 220-250 μm total length x 10-13 μm broad, the spore-bearing part 90-120 μm long, the stipe 100-150 μm long, with apical ring bluing in Melzer's iodine reagent, discoid, 1-1.5 μm high x 4.5-5 μm broad. Ascospores dark brown, unicellular, ellipsoid to cylindrical, highly variable, inequilateral, slightly inequilateral to equilateral, with broadly to narrowly rounded ends sometimes pinched, 14-22 (-25.5) x 7-11 µm, with straight germ slit spore-length on more convex side; perispore indehiscent in 10% KOH; epispore smooth.

Colonies on 2% Difco Oatmeal Agar at ca. 20°C and under 12 h fluorescent light reaching the edge of 9 cm Petri dish in 1.5 wk, whitish, felty, azonate, with diffuse margins, becoming zonate, with greenish olivaceous (90) and olivaceous (48) alternating zones; reverse dull green (70). Sporulating regions scattered over entire surface of colony but with more abundant sporulation at edge of colony, buff (45) to honey (64). Conidiogenous structure approaching ***Virgariella***-like branching pattern as defined in Ju and Rogers (1996). Conidiophores mononematous, dichotomously branched, sometimes with additional branches arising from the first level of conidiogenous regions, hyaline to yellowish, finely roughened, 2.5-3 µm diam, with two, less frequently three, conidiogenous cells arising from each terminus. Conidiogenous cells cylindrical, hyaline, finely roughened, 10-20 x 2-3.5 µm. Conidia produced holoblastically in sympodial sequence. Conidia hyaline, smooth to finely roughened, ellipsoid, with flattened base, 7-9.5 x 4-5 µm.

SPECIMENS EXAMINED: MEXICO: Nuevo León state, San Roque, no date, Jorge, R. F. 1, on wood in oak forest (UNL); Tamaulipas state, Gómez Farías town, 12.VIII.1988, Guevara 525, wood (ITCV; JDR). NEW ZEALAND: Chatham Islands, N. Kau Bush, 18.XI.1992, Johnston, P. R. C25 (CULTURED), wood (PDD 61834). U.S.A.: California, near Sacramento, IV.1909, Sutliff, cottonwood stump (BPI 716988 [Lloyd herb. 10941], PARATYPE of ***Daldinia grandis***); California, Ojai Valley, Sisas Creek, collection data unknown, sent by Mahoney, D. P., wood of ***Umbellaria californica*** (JDR); Washington, Sequim, Grant, J. M., wood, as ***Daldinia californica*** C. G. Lloyd, *ined.* (BPI 716340 [Lloyd herb. 12378], HOLOTYPE of ***Daldinia concentrica*** *f.* ***californica***); Washington, Richland, along Yakima River, 27.VI.1940, Fisher & Nyland, wood of ***Salix*** (JDR).

NOTES: The description of cultures is based on a collection from Chatham Islands, New Zealand. ***Daldinia grandis*** has been reported from New Zealand by Child (1932). However, the type locality of ***D. grandis*** is in California, U.S.A. Unfortunately, there do not seem to be published data on the anamorph of ***D. grandis*** from western United States. The conidiogenous structure is in general ***Virgariella***-like. However, it deviates from the typical ***Virgariella***-like branching pattern in having more robust conidiophores and in having three conidiogenous cells born on top of some terminal branches of conidiophores.

We did not see the holotype of ***D. grandis*** which was said to be deposited at the Paul Shope herbarium, Boulder, Colorado (Child, 1932). The photographs of stromata and ascospores from the holotype in Child (1932) leave no doubt as to the identity of ***D. grandis***. This fungus is closely related to ***D. loculata*** but differs from the latter in having larger, more variable ascospores.

Daldinia lloydii Y.-M. Ju, J. D. Rogers, & San Martín, *nom. nov.*
Figs. 13, 47, 48

≡ ***Hypoxylon fissum*** C. G. Lloyd, Mycol. Writings 7: 1121. 1922; *non* ***Daldinia fissa*** C. G. Lloyd, 1924.

Stromata spherical to hemispherical, sessile, solitary to aggregated, lacking perithecial mounds, 1-3 cm diam x 1-2.2 cm high; surface blackish, densely covered with fulvous (43) polygonal scales; dull brown granules immediately beneath surface, without apparent KOH-extractable pigments; the tissue between perithecia brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.2-0.3 mm thick, the lighter zones brown, mixed with pithy to woody and gelatinous materials, persistent, 0.5 mm thick. Perithecia tubular, 0.3-0.4 mm diam x 1 mm high. Ostioles obsolete. Asci not observed. Ascospores dark brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, 12-16 x 6-7.5 μm, with straight germ slit spore-length on convex side; perispore dehiscent in 10% KOH, smooth; epispore smooth.

Anamorph unknown.

SPECIMENS EXAMINED: U.S.A.: Idaho, Idaho Co., bottom of Squaw Creek, 12.VII.1967, Goree, H., dead branches of ***Betula papyrifera***, as ***Daldinia*** *sp.* (WSP 57303), immature; New York, Fairman, C. E., birch pole (BPI 11522, HOLOTYPE of ***Hypoxylon fissum***).

NOTES: ***Daldinia lloydii*** is like ***D. grandis*** in that the lighter concentric zones are darker than those of other species and consist of gelatinous and woody to pithy materials, i.e., compared with other ***Daldinia*** taxa, this fungus has less color contrast between darker and lighter zones. The ochraceous brown outermost stromatal layer is cracked in a reticulate manner and is peculiar to this ***Daldinia*** taxon.

Daldinia loculata (Lév.) Sacc., Syll. Fung. I, p. 394. 1882.
Figs. 14, 51, 52

≡ ***Sphaeria loculata*** Lév., Ann. Sci. Nat. Bot., sér. III, 3: 47. 1845.
= ***Daldinia occidentalis*** Child, Ann. Missouri Bot. Gard. 19: 453. 1932.

This fungus is much like ***D. grandis*** except for having smaller ascospores, 11-14 (-15.5) x 6-8 (-8.5) μm.

The anamorph has been reported by Jong (1970) [as ***D. occidentalis***] on PDYA and by Martin (1969) [as ***D. occidentalis***] on 2% malt agar. Jong (1970) described and illustrated the conidiogenous structure with a ***Nodulisporium***-like branching pattern as defined by Ju and Rogers (1996). He gave a conidial size range 7-11 x 4-8 μm. On the other hand, Martin (1969) stated that conidiophores of this fungus are "hardly distinct from the vegetative mycelium" and conidia are "long clavate to botuliform, white en masse, 1.2-3.1 x 4.3-7.5 μ, ave. 2.4-5.4 μ".

SPECIMENS EXAMINED: U.S.A.: locality unknown, wood (PC, HOLOTYPE of ***Sphaeria loculata***); California, Shasta Co., Lassen National Park, 18.VII.1965, Smith, D., wood of ***Populus tremuloides***, as ***Daldinia occidentalis*** by Tarry, J. (WSP 56516); Colorado, Uncompaghre National Forest, Hedgcock, G. G., wood of ***Populus tremuloides***, as ***Daldinia occidentalis*** by Child, M. (BPI 594599), immature; South Dakota, Black Hills, 1903, von Schrenk, H., Herb. Missouri Bot. Gard. 43121, wood, as ***Daldinia concentrica*** by Hill, C. (BPI 594265, HOLOTYPE of ***Daldinia***

occidentalis); Washington, Northport, IX.1928, Hedgcock, G. G., wood of ***Betula occidentalis***, as ***Daldinia occidentalis*** by Miller, J. H. (BPI 594601); Washington, Northport, 16.VII.1931, Hedgcock, G. G. 54613, wood of ***Betula occidentalis***, as ***Daldinia grandis*** by ? (WSP 64950, *ex* BPI).

NOTES: ***Daldinia grandis*** and ***D. loculata*** could be considered as varieties of the same species because they differ from each other solely in the ascospore size ranges. In addition, they are mainly distributed in western North America.

As already noted by Petrini and Müller (1986), ***Daldinia loculata*** *sensu* Child (1932) and its type material are different. ***Daldinia cudonia*** is here used as the equivalent of Child's ***D. loculata*** which was characterized by Child (1932) as having slenderly stipitate stromata. The type of ***D. loculata***, in fact, is the same as Child's ***D. occidentalis***, a taxon with sessile or subsessile stromata. Under ***D. loculata***, Child (1932) also listed "***Daldinia intermedia*** Lloyd", a herbarium name used by C. G. Lloyd, as a synonym. The type to which this name is attached is conspecific with ***D. concentrica***. It is puzzling as to how Child (1932) adopted her concept of ***D. loculata***, especially after Lloyd (1919, p. 901) had commented that "the type at Paris has no stipe at all".

Daldinia macrospora San Martín, Y.-M. Ju, & J. D. Rogers, *sp. nov.*
Figs. 15, 56-58

Etymology: Refers to the large ascospores.

Stromata turbinata, brevia stipitata, rugosa, sine tumulis peritheciorum, 3 cm diam x 2.7 cm alta; externe griseo-sepiacea; sub superficie granulis brunneis conspersa, granulis atrolividis in KOH dissolutis; textura inter perithecia griseo-brunnea medullosa vel lignea; textura sub peritheciis zonis alternantibus composita, zonis fuscis medullosis vel ligneis, 0.8 mm crassis et zonis albis, gelatinosis, fatiscentibus et loculatis in sicco, 1-1.3 mm crassis praedita. Perithecia tubularia, 0.4-0.5 mm diam x 1.6-2 mm alta. Ostiola papillata. Asci non intacti, annulo apicali in liquore iodato Melzeri cyanescente, discoideo, 1 μm alto x 4 μm lato. Ascosporae brunneae, unicellulares, ellipsoideo-inequilaterales, apicibus angustatis, 22.5-30 x 8.5-10.5 μm, rima germinativa recta longa in latere convexo praeditae; perisporium in KOH dehiscens, leve; episporium leve.

Stromata turbinate, short stipitate, wrinkled, lacking perithecial mounds, 3 cm diam x 2.7 cm high; surface grayish sepia (106); dull brown granules immediately beneath surface, with KOH-extractable pigments dark livid (80); the tissue between perithecia grayish brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.8 mm thick, the lighter zones white, gelatinous when fresh, disintegrating and becoming loculate when dry, 1-1.3 mm thick. Perithecia tubular, 0.4-0.5 mm diam x 1.6-2 mm high. Ostioles papillate. Asci fragmentary, with apical ring bluing in Melzer's iodine reagent, discoid, 1 μm high x 4 μm broad. Ascospores brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, 22.5-30 x 8.5-10.5 μm, with straight germ slit spore-length on convex side; perispore dehiscent in 10% KOH, smooth; epispore smooth.

Anamorph unknown.

SPECIMEN EXAMINED: MEXICO: Jalisco state, Colima's Volcano, 21.VI.1987, Villaseñor, L. s/n, wood of ***Quercus*** (IBUG, HOLOTYPE; WSP 69651, ISOTYPE of ***Daldinia macrospora***).

NOTES: This fungus has the longest ascospores known in ***Daldinia***. Its stromatal features are in general similar to those of ***D. fissa***.

Daldinia mexicana San Martín, Y.-M. Ju, & J. D. Rogers, *sp. nov.*
Figs. 16, 53-55

Etymology: After Mexico.

A Daldinia gelatinosa differt in pigmentis stromatum melleis, isabellinis, vel hinnuleis.

This fungus is much like ***D. gelatinosa*** except for having KOH-extractable stromatal pigments honey (64), isabelline (65), or fawn (87). Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, 12.5-15.5 x 6.5-7.5 μm, with straight germ slit spore-length on convex side; perispore dehiscent in 10% KOH, smooth; epispore smooth.

Anamorph unknown.

SPECIMENS EXAMINED: MEXICO: Coahuila state, Arteaga municipality, alt. 2700 m. 24.VI.1984, Jiménez & Castillo 18, wood of ***Quercus*** (ITCV; JDR); Durango state, km 16 Durango-Mazatlán road, 3.IX.1983, García 3498, wood of ***Quercus*** (ITCV; JDR); Jalisco state, Zapopan, 21.VIII.87, Guzmán-Dávalos 3991, wood of ***Quercus*** (IBUG); Nuevo León state, Zaragoza municipality, "La Encantada", no date, Cázares 600A, wood of ***Quercus*** (ITCV, HOLOTYPE; WSP 69650, ISOTYPE of ***Daldinia mexicana***); Nuevo León state, Zaragoza municipality, "La Encantada", 18.X.1985, Guevara, G. 653, wood of ***Quercus*** (ITCV; JDR).

NOTES: This fungus differs from ***D. gelatinosa*** mainly in the stromatal pigments. Moreover, ***Daldinia mexicana*** is known only from Mexico, while ***D. gelatinosa*** occurs in temperate North America.

Daldinia petriniae Y.-M. Ju, J. D. Rogers, & San Martín, *sp. nov.*
Figs. 17, 59-61, 76

Etymology: After the Swiss mycologist, Liliane E. Petrini.

Stromata sphaerica, hemisphaerica, vel placentiformia, sessilia vel fere sessilia, solitaria vel aggregata, tumulis peritheciorum inconspicuis vel conspicuis, 1-5.8 cm diam x 0.9-3.4 cm alta; externe fusca, demum denigrata et laccata; sub superficie granulis rufobrunneis conspersa, granulis livido-purpureis vel atrolividis in KOH dissolutis; textura inter perithecia brunnea medullosa vel lignea; textura sub peritheciis zonis alternantibus composita, zonis fuscis medullosis vel ligneis, 0.3-0.6 mm crassis et zonis brunneis medullosis vel ligneis, persistentibus, 0.5-1.5 mm crassis praedita. Perithecia tubularia, 0.3-0.4 mm diam x 1-1.5 mm alta. Ostiola papillata. Asci 200-230 μm longitudine tota x 8-9 μm crassi, partibus sporiferis 90-100 μm longitudine, stipitibus 110-140 μm longitudine, annulo apicali in liquore iodato Melzeri cyanescente, discoideo, 1 μm alto x 4 μm lato. Ascosporae brunneae vel fuscae, unicellulares, ellipsoideo-inequilaterales, apicibus angustatis, 12.5-16.5 x (6-) 6.5-7.5 μm, rima germinativa recta, longa in latere convexo praeditae; perisporium in KOH dehiscens, leve; episporium leve.

Stromata spherical, hemispherical, or placentiform, sessile or nearly so, solitary to aggregated, with inconspicuous to conspicuous perithecial mounds, 1-5.8 cm diam x 0.9-3.4 cm high; surface fuscous (103), blackened and varnished in age; dull reddish brown granules immediately beneath surface, with KOH-extractable pigments livid purple (81) or dark livid (80); the tissue between perithecia brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.3-0.6 mm thick, the lighter zones brown, pithy to woody, persistent, 0.5-1.5 mm thick. Perithecia tubular, 0.3-0.4 mm diam x 1-1.5 mm high. Ostioles papillate. Asci 200-230 μm total length x 8-9 μm broad, the spore-bearing part 90-100 μm long, the stipe 110-140 μm long, with apical ring bluing in Melzer's iodine reagent, discoid, 1 μm high x 4 μm broad. Ascospores brown to dark brown, unicellular, ellipsoid-inequilateral, with narrowly rounded ends, 12.5-16.5 x (6-) 6.5-7.5 μm, with straight germ slit spore-length on convex side; perispore dehiscent in 10% KOH, smooth; epispore smooth.

Colonies on 2% Difco Oatmeal Agar at ca. 20°C and under 12 h fluorescent light reaching the edge of 9 cm Petri dish in 1.5-2 wk, whitish, felty, azonate, with diffuse margins, becoming honey (64); reverse citrine (13). Sporulating regions scattered over entire surface of colony, but with more abundant sporulation on tufts of hyphae at edge of colony, pale luteous (11). Conidiogenous structure with ***Sporothrix***-like to ***Nodulisporium***-like branching pattern as defined in Ju and Rogers (1996). Conidiophores mononematous, unbranched or dichotomously branched, hyaline, coarsely roughened, 2.5-3 μm diam, with 1-3 conidiogenous cells arising from each terminus. Conidiogenous cells clavate, hyaline, roughened, 10-20 x 3-5 μm. Conidia produced from percurrently proliferating conidiogenous cells or, infrequently, from sympodially proliferating conidiogenous cells. Conidia hyaline, smooth, subglobose to obovoid, usually with an attenuated flattened base, (5.5-) 7-9 x (4.5-) 5-6 (-7) μm.

SPECIMENS EXAMINED: FRANCE: no. 313, "in Fago", as ***Sphaeria concentrica*** by Persoon, C. H. (L 910.270-331). SWITZERLAND: Kt. Graubünden, Ramosch, Resgia, 29.VIII.1986, Petrini, L. & O., (CULTURED), wood of ***Alnus incana***, as ***Daldinia occidentalis*** (WSP 69648, HOLOTYPE of ***Daldinia petriniae***). U.K.: North Wales, Anglesey, vic. Menai Bridge, IV.1979, Whalley, A. J. S. & Rogers, J. D., wood (JDR).

NOTES: ***Daldinia petriniae*** is known only from Europe thus far. It is similar to ***D. eschscholzii*** from which it differs in having conspicuously papillate ostioles, in having a larger ascospore size range in average, in having larger conidia, and frequently in having annellated proliferation in conidiogenous loci indicating percurrent conidiogenous cell proliferation. ***Daldinia petriniae*** is also similar to ***D. loculata*** from which it differs mainly in having strongly inequilateral ascospores and in having a dehiscent ascospore perispore. It is not yet known if the young stromata of ***D. petriniae*** have gelatinous material in the lighter concentric zones as does ***D. grandis***. ***Daldinia petriniae*** is equivalent to ***D. occidentalis*** *sensu* Petrini and Müller

(1986). The anamorph as described by Petrini and Müller (1986) from culture is much as described herein. Conidia described by them from stromata range larger, but we did not observe conidia on stromata.

Daldinia sacchari Dargan & Thind, Kavaka 12: 114. 1984.

Figs. 62-64, 69

Stromata turbinate, sessile or with short, stout stipe, solitary, with inconspicuous to conspicuous perithecial mounds, 8-10 mm diam x 6-10 mm high; surface vinaceous buff (86) to grayish sepia (106); dull reddish brown granules immediately beneath surface, without apparent KOH-extractable pigments; the tissue between perithecia whitish, gray, or brown, pithy to woody; the tissue below the perithecial layer composed of alternating zones, the darker zones dark brown, pithy to woody, 0.2 mm thick, the lighter zones whitish, pithy to woody, persistent, 1-2 mm thick. Perithecia obovoid, 0.3 mm diam x 0.8 mm high. Ostioles at the same level as the stromatal surface. Asci 135-175 μm total length x 9.5-11 μm broad, the spore-bearing part 90-110 μm long, the stipe 50-65 μm long, with apical ring bluing in Melzer's iodine reagent, discoid, 0.5 μm high x 3 μm broad. Ascospores brown, unicellular, ellipsoid-inequilateral, with narrowly to, infrequently, broadly rounded ends, 15.5-18 x 6.5-7.5 μm, with straight germ slit spore-length or nearly so on convex side; perispore indehiscent in 10% KOH; epispore smooth.

Anamorph unknown.

SPECIMEN EXAMINED: INDIA: Union Territory, Chandigarh, 20.VIII.1966, Chahal, H. S. 70, burnt stems of ***Saccharum munja*** (K, ISOTYPE of ***Daldinia sacchari***).

NOTES: Stromata of ***D. sacchari***, like those of ***D. graminis***, are fairly small. Both of them grow on monocots and have an indehiscent ascospore perispore. They differ from each other mainly in the ascospore dimensions and in the length of germ slit.

Dargan and Thind (1984) recognized two subgenera for ***Daldinia***, ***Eudaldinia*** and ***Entodaldinia***, mainly on the basis of stromatal anatomy. They selected ***D. sacchari*** as the type of subgenus ***Entodaldinia***.

LIST OF NAMES

Accepted or suggested disposition is indicated by an asterisk. Probable disposition is indicated by a question mark.

albozonata (***Daldinia***) C. G. Lloyd = * ***Daldinia clavata*** Henn.
angolensis (***Daldinia***) (Welw. & Curr.) Sacc., Syll. Fung. I, p. 394. 1882.
  ≡ ***Hypoxylon angolense*** Welw. & Curr., Trans. Linn. Soc. 26: 282. 1867.
  ≡ ***Rhopalopsis angolensis*** (Welw. & Curr.) Cooke, Grevillea 11: 93. 1883.
  ≡ ***Kretzschmaria angolensis*** (Welw. & Curr.) Sacc., Syll. Fung. IX, p. 565. 1891.

≡ * ***Rhopalostroma angolense*** (Welw. & Curr.) D. Hawksworth, Kew Bull. 31: 424. 1977.

aparaphysata (***Daldinia***) Saccas = ? ***Daldinia caldariorum*** Henn.

argentinensis (***Daldinia***) Speg. = * ***Daldinia clavata*** Henn.

argentinensis (***Daldinia***) Speg. *var.* ***sessilis*** Speg. = * ***Daldinia clavata*** Henn.

aspera (***Daldinia***) Massee, Kew Bull., Misc. Inf. 1898: 134. 1898.

= * ***Neohypodiscus cerebrinus*** (Fée) J. D. Rogers, Y.-M. Ju, & Laessøe. See Rogers et al. (1994).

asphalatum (***Daldinia***) (Link: Fr.) Sacc., Syll. Fung. I, p. 394. 1882.

≡ ***Sphaeria asphalatum*** Link *apud* Fr., Linnaea 5: 540. 1830; Link: Fr., Syst. Mycol. Index, p. 160. 1832.

≡ ***Hypoxylon asphalatum*** (Link: Fr.) Mont., Ann. Sci. Nat. Bot., sér. IV, 3: 118. 1855.

Type material appears to be missing (Dennis, 1963; Miller, 1961; Ju and Rogers, 1996). Child (1932) suspected this fungus to be a ***Hypoxylon***. Miller (1961) listed these names as possible synonyms of ***H. sclerophaeum*** Berk. & M. A. Curtis.

atrum (***Lycoperdon***) Schaeff. = * ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not.

* ***bakeri*** (***Daldinia***) C. G. Lloyd

* ***bambusicola*** (***Daldinia***) Y.-M. Ju, J. D. Rogers, & San Martín

barbata (***Daldinia***) Rick = * ***Daldinia clavata*** Henn.

* ***brachysperma*** (***Daldinia***) San Martín, Y.-M. Ju, & J. D. Rogers

* ***caldariorum*** (***Daldinia***) Henn.

cingulata (***Daldinia***) (Lév.) Sacc., Syll. Fung. I, p. 395. 1882.

≡ ***Sphaeria cingulata*** Lév., Ann. Sci. Nat. Bot., sér. III, 3: 47. 1845; *non* Mont., 1834; [*nom. rejic.*, ICBN Art. 64.1].

Daldinia cingulata was cited by Ellis and Everhart (1892) as being doubtfully distinct from ***D. vernicosa*** [= ***D. fissa***]. It was subsequently listed as a doubtful synonym of ***D. vernicosa*** by Child (1932). Unfortunately, we failed to locate the type material at K and PC. In the protologue, only gross morphology was described. Although the gross morphology does suggest ***D. fissa***, we hesitate to synonymize ***D. cingulata*** with it owing to the lack of microscopic data, particularly ascospore morphology. ***Sphaeria cingulata*** Lév. is a later homonym of ***S. cingulata*** Mont. [Ann. Sci. Nat. Bot., sér. II, 1: 340. 1834.] and is therefore illegitimate. The latter appears to be a ***Karstenula*** Speg., a melanommatalean fungus.

* ***clavata*** (***Daldinia***) Henn.

cognata (***Daldinia***) Har. & Pat. = * ***Daldinia caldariorum*** Henn.

colensoi (***Hypoxylon***) Berk. *apud* Hook., Handb. of N. Zealand Fl., p. 756. 1867.

≡ ***Kretzschmaria colensoi*** (Berk.) Sacc., Syll. Fung. II, p. xxix. 1883.

NEW ZEALAND: Colenso 4632, wood (K, HOLOTYPE of ***Hypoxylon colensoi***).

A ***Daldinia*** with immature and fragmentary stromata.

* ***concentrica*** (***Daldinia***) (Bolton: Fr.) Ces. & De Not. ≡ ***Sphaeria concentrica*** Bolton: Fr. *non* Wahlenberg ≡ ***Peripherostoma concentricum*** (Bolton: Fr.) S. F. Gray ≡ ***Stromatosphaeria concentrica*** (Bolton: Fr.) Grev. ≡ ***Hypoxylon concentricum*** (Bolton: Fr.) Grev. ≡ ***Hemisphaeria concentrica*** (Bolton: Fr.) Klotzsch

concentrica (***Daldinia***) (Bolton: Fr.) Ces. & De Not. *f.* ***californica*** C. G. Lloyd = * ***Daldinia grandis*** Child

concentrica (***Daldinia***) (Bolton: Fr.) Ces. & De Not. *f.* ***clavata*** (Henn.) Theiss. ≡ * ***Daldinia clavata*** Henn.

concentrica (***Daldinia***) (Bolton: Fr.) Ces. & De Not. *f.* ***confluens*** C. G. Lloyd = * ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not.

concentrica (***Daldinia***) (Bolton: Fr.) Ces. & De Not. *var.* ***eschscholzii*** (Ehrenb.: Fr.) Starb. ≡ ***Sphaeria concentrica*** Bolton: Fr. *var.* ***eschscholzii*** (Ehrenb.: Fr.) Fr. ≡ * ***Daldinia eschscholzii*** (Ehrenb.: Fr.) Rehm

concentrica (***Daldinia***) (Bolton: Fr.) Ces. & De Not. *f.* ***intermedia*** C. G. Lloyd = * ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not.

concentrica (***Daldinia***) (Bolton: Fr.) Ces. & De Not. *var.* ***microspora*** (Starb.) Theiss., Ann. Mycol. 7: 3. 1909.

See the entry ***D. vernicosa*** (Schwein.) Ces. & De Not. *f.* ***microspora*** Starb.

concentrica (***Daldinia***) (Bolton: Fr.) Ces. & De Not. *var.* ***minuta*** Waraitch = * ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not.

concentrica (***Daldinia***) (Bolton: Fr.) Ces. & De Not. *var.* ***obovata*** (Fr.: Fr.) Sacc. ≡ ***Sphaeria concentrica*** Bolton: Fr. *var.* ***obovata*** Fr.: Fr. = * ***Daldinia fissa*** C. G. Lloyd

concentrica (***Sphaeria***) Bolton: Fr. *var.* ***pedicellata*** Pers. = * ***Daldinia fissa*** C. G. Lloyd

concentricum (***Hypoxylon***) (Bolton: Fr.) Grev. *var.* ***minus*** Berk. & Broome, Trans. Linn. Soc. London, Bot. II, 2: 70. 1883.

Berkeley and Broome (1883) considered this to be a small stromatal form of the typical variety. We have not studied material of this fungus.

corrugata (***Daldinia***) Pat. & Har. = ? ***Daldinia caldariorum*** Henn.

* ***cudonia*** (***Daldinia***) (Berk. & M. A. Curtis) C. G. Lloyd ≡ ***Xylaria cudonia*** Berk. & M. A. Curtis

* ***cuprea*** (***Daldinia***) Starb.

durissima (***Daldinia***) (Fr.) Sacc., Syll. Fung. I, p. 394. 1882.

≡ ***Sphaeria concentrica*** Wahlenberg, Fl. Lapp., p. 517. 1812; *non* Bolton [: Fr.], 1789; [*nom. rejic.*, ICBN Arts. 13.1(d) & 64.1].

≡ ***Hypoxylon durissimum*** Fr., Summa Veg. Scand. II, p. 384. 1849; *non* (Schwein.: Fr.) Sacc., 1882; [*nom. rejic.*, ICBN Art. 13.1(d)].

We were unable to locate the type. ***Hypoxylon durissimum*** Fr. was erected as a substitute for ***Sphaeria concentrica*** Wahlenberg which is a later homonym of ***S. concentrica*** Bolton: Fr. Nonetheless, ***Hypoxylon durissimum*** Fr. became illegitimate after ***Sphaeria durissima*** Schwein.: Fr., a sanctioned name in Fries (1823), had been combined with ***Hypoxylon***. Cooke (1883) considered Fries' ***H. durissimum*** to be a synonym of ***H. marginatum*** (Schwein.) Berk. [≡ ***H. annulatum*** (Schwein.: Fr.) Mont.]. Child (1932) remarked that this fungus is doubtfully ***D. concentrica*** (Bolton: Fr.) Ces. & De Not.

eschscholzii (***Daldinia***) (Ehrenb.: Fr.) Rehm ≡ ***Sphaeria eschscholzii*** Ehrenb.: Fr.

exsurgens (***Daldinia***) (Mont.) Rehm, Ann. Mycol. 7: 4. 1909.

≡ ***Hypoxylon exsurgens*** Mont., Ann. Sci. Nat. Bot., sér. IV, 3: 118. 1855.

≡ ***Hypodiscus exsurgens*** (Mont.) Rick, Brotéria, sér. Bot., 25: 34. 1931.

GUYANA: Leprieur, C. 532, corticated wood (PC, HOLOTYPE of ***Hypoxylon exsurgens***).

The holotype is sterile. The stromata have the bipartite structure of ***Biscogniauxia*** Kuntze and ***Camillea*** Fr. Also see Rogers et al. (1994).

feei (***Daldinia***) Sacc., Syll. Fung. I, p. 395. 1882.

≡ ***Sphaeria vernicosa*** Fée, Nouv. Mém. Soc. Sci. Bas-Rhin 2: Pl. 12, Fig. 2. 1834; *non* DC. & Lam. [: Fr.], 1815; *nec* Schwein., 1825 [*nom. rejic.*, ICBN Arts. 13.1(d) & 64.1].

≡ ***Xylaria vernicosa*** (Fée) Sacc., Syll. Fung. IX, p. 530. 1891.

Daldinia feei was teated in "doubtful or excluded species" by Child (1932) who was inclined to consider it a ***Xylaria***. We have not studied material of this fungus.

* ***fissa*** (***Daldinia***) C. G. Lloyd

fissum (***Hypoxylon***) C. G. Lloyd ≡ * ***Daldinia lloydii*** Y.-M. Ju, J. D. Rogers, & San Martín

fraxinea (***Sphaeria***) Sibth. = * ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not.

fraxineum (***Lycoperdon***) Hudson = * ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not.

* ***gelatinosa*** (***Daldinia***) Y.-M. Ju, J. D. Rogers, & San Martín

gollani (***Daldinia***) Henn. = * ***Daldinia caldariorum*** Henn.

* ***graminis*** (***Daldinia***) Dargan & Thind

* ***grandis*** (***Daldinia***) Child

granulosa (***Daldinia***) Speg. = * ***Daldinia cuprea*** Starb.

hibiscus (***Daldinia***) (Henn.) C. G. Lloyd ≡ ***Hypoxylon hibisci*** Henn. = * ***Daldinia caldariorum*** Henn.

* ***lloydii*** (***Daldinia***) Y.-M. Ju, J. D. Rogers, & San Martín

* ***loculata*** (***Daldinia***) (Lév.) Sacc. ≡ ***Sphaeria loculata*** Lév.

luzonensis (***Daldinia***) Rehm = * ***Daldinia eschscholzii*** (Ehrenb.: Fr.) Rehm

* ***macrospora*** (***Daldinia***) San Martín, Y.-M. Ju, & J. D. Rogers

malleola (***Daldinia***) (Berk. & Ravenel) Kauffm., Pap. Michigan Acad. Sci. 11: 168. 1930.

≡ ***Hypoxylon malleolus*** Berk. & Ravenel *apud* Berk., Grevillea 4: 49. 1875.

These are synonyms of ***Hypoxylon thouarsianum*** (Lév.) C. G. Lloyd. See Miller (1961) and Ju and Rogers (1996) for descriptions of this fungus.

* ***mexicana*** (***Daldinia***) San Martín, Y.-M. Ju, & J. D. Rogers

* ***murrillii*** (***Daldinia***) C. G. Lloyd = * ***Daldinia cudonia*** (Berk. & M. A. Curtis) C. G. Lloyd

occidentalis (***Daldinia***) Child = * ***Daldinia loculata*** (Lév.) Sacc.

* ***petriniae*** (***Daldinia***) Y.-M. Ju, J. D. Rogers, & San Martín

placenta (***Hypoxylon***) (Link: Fr.) Sacc., Syll. Fung. I, p. 369. 1882; *non* Kalchbr., 1880.

≡ ***Sphaeria placenta*** Link *apud* Fr., Linnaea 5: 539. 1830; Link: Fr., Syst. Mycol. Index, p. 171. 1832; *non* Tode, 1791.

We were unable to locate the type at B or UPS. This was listed as a synonym of ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not. by Child (1932). Fries (1830) briefly described this fungus as "hemisphaerico-globosa, extus intusque atra, intus azona, peritheciis periphericis globosis, ostiolis papuloso-hemisphaericis." It is really doubtful that this fungus is a ***Daldinia*** because Fries (1830) stressed the azonate nature of the stromata.

placentiformis (***Daldinia***) (Berk. & M. A. Curtis) Theiss., Ann. Mycol. 7: 4. 1909.

≡ * ***Hypoxylon placentiforme*** Berk. & M. A. Curtis, J. Linn. Soc., Bot. 10: 383. 1869.

≡ ***Nummularia placentiformis*** (Berk. & M. A. Curtis) Sacc., Syll. Fung. I, p. 399. 1882.

≡ ***Hypodiscus placentiformis*** (Berk. & M. A. Curtis) Rick, Brotéria, sér. Bot., 25: 34. 1931.

See Ju and Rogers (1996) for a description. Also see Rogers et al. (1994).

platensis (***Daldinia***) Speg. = * ***Daldinia caldariorum*** Henn.

* ***sacchari*** (***Daldinia***) Dargan & Thind

simile (***Hypoxylon***) C. G. Lloyd = * ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not.

simulans (***Daldinia***) Child = * ***Daldinia fissa*** C. G. Lloyd

stratosa (***Daldinia***) (Sacc.) Sacc. & Trott. ≡ ***Hypoxylon stratosum*** Sacc. = * ***Daldinia eschscholzii*** (Ehrenb.: Fr.) Rehm

thouarsiana (***Daldinia***) (Lév.) Sacc., Syll. Fung. I, p. 395. 1882.

≡ ***Sphaeria thouarsiana*** Lév., Ann. Sci. Nat. Bot., sér. III, 5: 258. 1846.

≡ * ***Hypoxylon thouarsianum*** (Lév.) C. G. Lloyd, Mycol. Writings 5: 26. 1919.

See Miller (1961) and Ju and Rogers (1996) for descriptions.

tuberosa (***Daldinia***) (Scop.) J. Schröt. ≡ ***Valsa tuberosa*** Scop. ≡ ***Sphaeria tuberosa*** (Scop.) Timm ≡ ***Hypoxylon tuberosum*** (Scop.) Wettst. = * ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not.

tunicata (***Sphaeria***) Tode = * ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not.

vernicosa (***Daldinia***) (Schwein.) Ces. & De Not. ≡ ***Sphaeria vernicosa*** Schwein. *non* DC. & Lam.: Fr., *nec* Fée ≡ ***Hypoxylon vernicosum*** (Schwein.) Berk. & M. A. Curtis *non* Ellis & Everh. = * ***Daldinia fissa*** C. G. Lloyd

vernicosa (***Daldinia***) (Schwein.) Ces. & De Not. *f.* ***microspora*** Starb., Bih. Kongl. Svenska Vetensk.-Akad. Handl. 27, 3: 6. 1901.

≡ ***Daldinia concentrica*** (Bolton: Fr.) Ces. & De Not. *var.* ***microspora*** (Starb.) Theiss., Ann. Mycol. 7: 3. 1909.

The type was not located at S. Child (1932) and Miller (1942) considered it to be a synonym of ***D. eschscholzii***.

warburgii (***Daldinia***) Henn., Hedwigia 32: 225. 1893.

INDONESIA: Celebes, Warburg, wood (S, LECTOTYPE [selected by Ju and Rogers (1996)] of ***Daldinia warburgii***).

This is either a ***Kretzschmaria*** Fr. or ***Ustulina*** Tul. & C. Tul.

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We dedicate this paper to C. T. Ingold in recognition of his many contributions toward understanding ***Daldinia*** and his long and distinguished career in mycology.

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FIGURE LEGENDS

Figs. 1-17. Ascospores. 1. ***Daldinia bakeri*** (holotype). 2. ***D. bambusicola*** (holotype). 3. ***D. brachysperma*** (isotype; WSP). 4. ***D. caldariorum*** (lectotype). 5. ***D. clavata*** (holotype). 6. ***D. concentrica*** (G. Gilles, from France; JDR). 7. ***D. cudonia*** (holotype). 8. ***D. cuprea*** (holotype). 9. ***D. eschscholzii*** (lectotype of ***D. luzonensis***). 10. ***D. fissa*** (holotype). 11. ***D. gelatinosa*** (holotype). 12. ***D. grandis*** (paratype; BPI 716988). 13. ***D. lloydii*** (holotype). 14. ***D. loculata*** (holotype). 15. ***D. macrospora*** (isotype; WSP). 16. ***D. mexicana*** (isotype; WSP). 17. ***D. petriniae*** (holotype). The scale bar represents 10 μm.

Figs. 18-32. ***Daldinia bakeri***, ***D. bambusicola***, ***D. brachysperma***, ***D. caldariorum***, ***D. concentrica***, and ***D. eschscholzii***. 18-20. ***D. bakeri*** (holotype). 18. Stroma; X1. 19. Stromatal surface; X16. 20. Concentric zones; X3. 21-23. ***D. bambusicola*** (holotype). 21. Stromata; X1.75. 22. Stromatal surface; X16. 23. Concentric zones; X3.75. 24, 25. ***D. brachysperma*** (isotype; WSP). 24. Stroma; X5.25. 25. Stromatal surface; X16. 26. ***D. caldariorum*** (lectotype). Stroma; X7. 27-29. ***D. concentrica*** (J. D. Rogers, from Itasca, Minnesota, U.S.A.; JDR). 27. Stromata; X1. 28. Stromatal surface; X16. 29. Concentric zones; X3.25. 30-32. ***D. eschscholzii*** (R. J. & A. A. Bandoni 9880, from Thailand; JDR). 30. Stromata; X1.25. 31. Stromatal surface; X16. 32. Concentric zones; X7.

Figs. 33-43. ***Daldinia clavata***, ***D. cudonia***, ***D. cuprea***, and ***D. fissa***. 33-35. ***D. clavata***. 33. Stroma; holotype of ***D. clavata***, X2. 34. Stromata; holotype of ***D. albozonata***, X1.33. 35. Stromatal surface; holotype of ***D. clavata***, X16. 36, 37. ***D. cuprea*** (holotype). 36. Part of a stroma; X1.5. 37. Stromatal surface; X16. 38, 39. ***D. cudonia*** (holotype). 38. Vertical section of a stroma showing a peripheral perithecial layer and concentric rings; X5. 39. Stromatal surface; X16. 40-43. ***D. fissa***. 40. Stroma; holotype of ***D. fissa***, X0.5. 41. Stromata; holotype of ***D. vernicosa***, X1. 42. Stromatal surface; holotype of ***D. simulans***, X16. 43. Concentric zones; holotype of ***D. vernicosa***, X16.

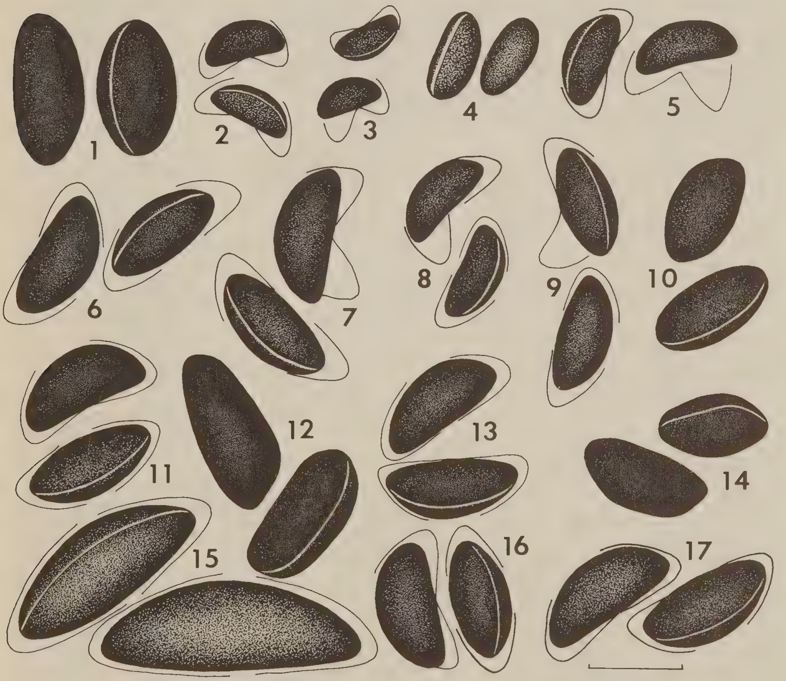
Figs. 44-55. ***Daldinia gelatinosa***, ***D. grandis***, ***D. lloydii***, ***D. loculata***, and ***D. mexicana***. 44-46. ***D. gelatinosa*** (holotype). 44. Stroma; X1.66. 45. Stromatal surface; X16. 46. Concentric zones; X5. 47, 48. ***D. lloydii*** (H. Goree, from Idaho, U.S.A.; WSP 57303). 47. Stroma; X3. 48. concentric zones; X4. 49, 50. ***D. grandis*** (holotype of ***D. concentrica f. californica***). 49. Stromata; X0.75. 50. Concentric zones; X2.66. 51, 52. ***D. loculata*** (holotype of ***D. occidentalis***). 51. Stroma; X1. 52. Concentric zones; X2. 53-55. ***D. mexicana*** (isotype; WSP). 53. Stromata; X1.33. 54. Stromatal surface; X16. 55. Concentric zones; X3.25.

Figs. 56-69. ***Daldinia macrospora***, ***D. petriniae***, ***D. sacchari***, and ***D. graminis***. 56-58. ***D. macrospora***. 56. Stroma; X2. 57. Stromatal surface; X16. 58. Concentric zones; X2.33. 59-61. ***D. petriniae***. 59. Stromata; X2.

60. Stromatal surface; X16. 61. Concentric zones; X5. 62-64. ***D. sacchari***. 62. Stroma; X8. 63. Concentric zones; X8. 64. Stromatal surface; X16. 65-68. ***D. graminis***. 65. Stromatal surface; X16. 66. Stroma; X5. 67. Concentric zones; X16. 68. Ascospore; X1700. 69. ***D. sacchari***. Ascospore; X1700.

Figs. 70-73. Conidiogenous structures and conidia. 70. ***D. caldariorum*** (F. San Martín 704) 71. ***D. clavata*** (F. San Martín 1024). 72. ***D. concentrica*** (J. D. Rogers, from France) 73. ***D. eschscholzii*** (J. F. Lawrence 3533). The scale bar represents 10 μm.

Figs. 74-76. Conidiogenous structures and conidia. 74. ***D. bambusicola*** (R. J. Bandoni & T. W. Flegel 10871). 75. ***D. grandis*** (P. R. Johnston C25). 76. ***D. petriniae*** (L. & O. Petrini, from Switzerland). The scale bar represents 10 μm.



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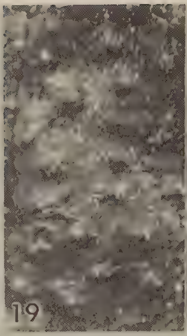
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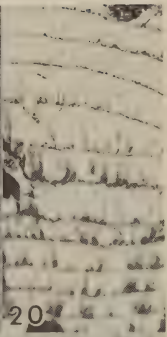
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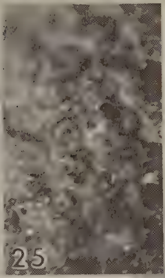
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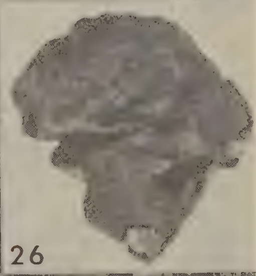
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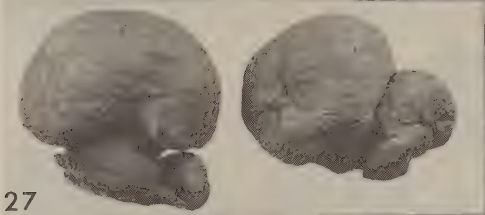
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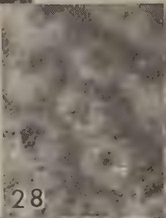
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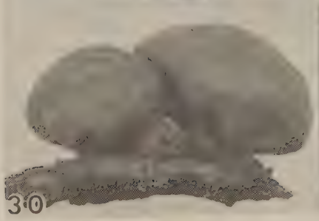
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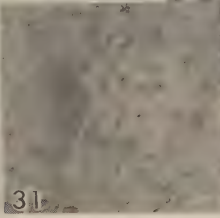
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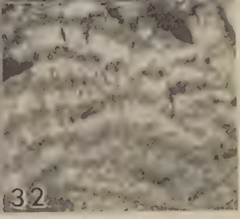
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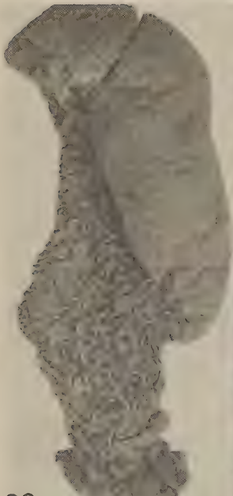
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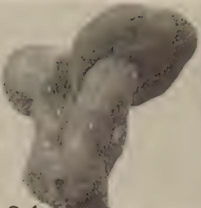
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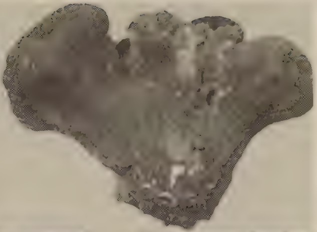

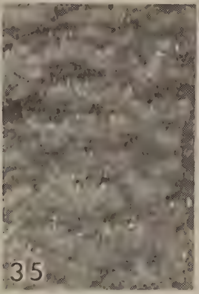
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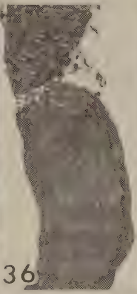
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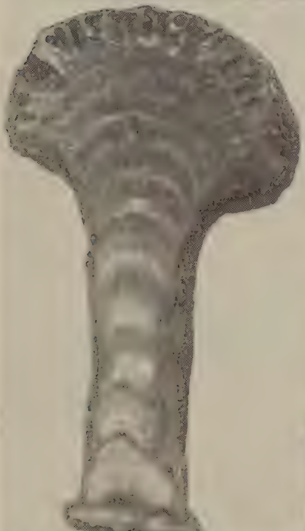
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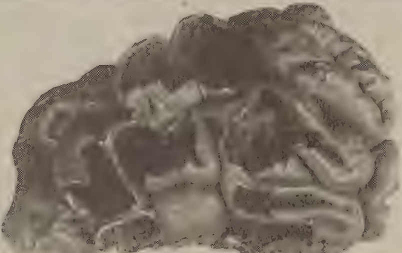
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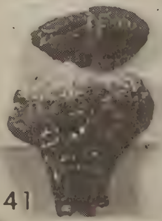
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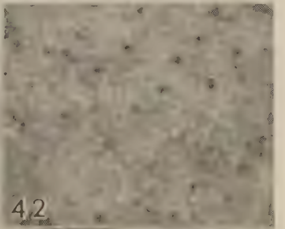
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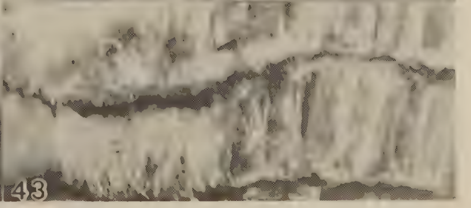
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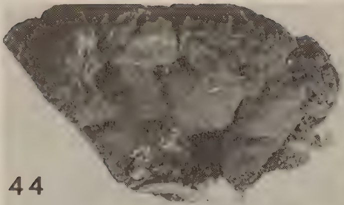
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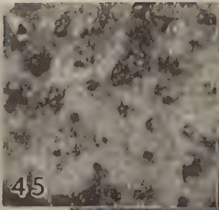
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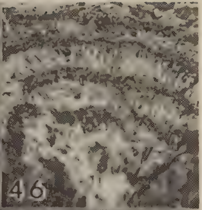
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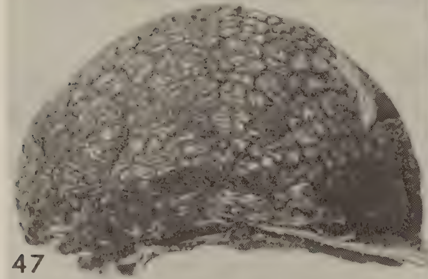
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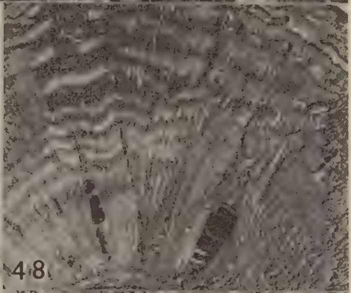
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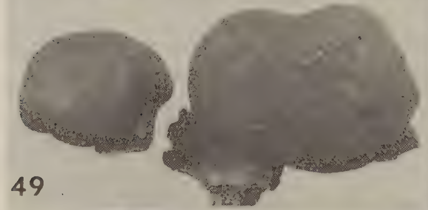
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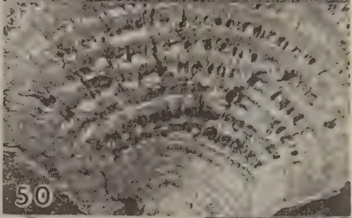
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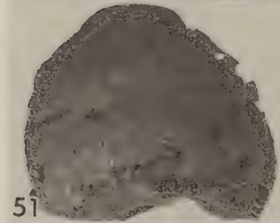
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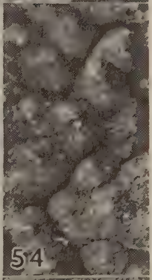
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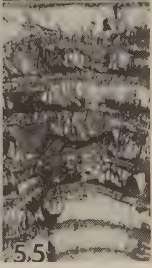
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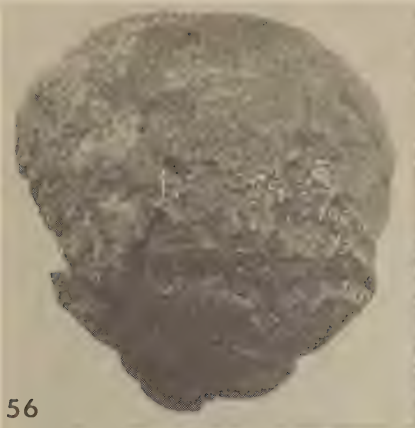
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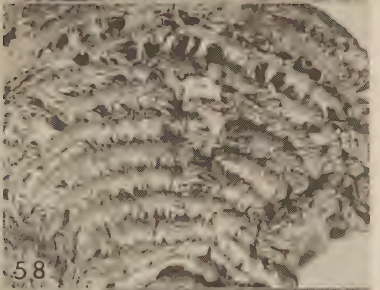
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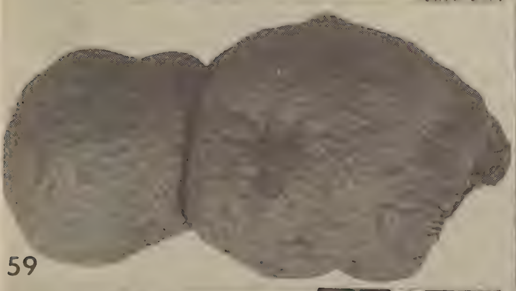
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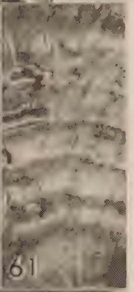
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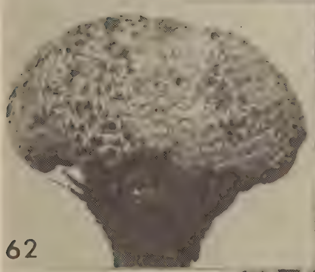
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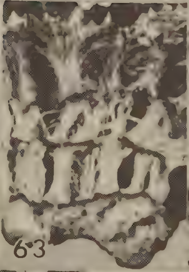
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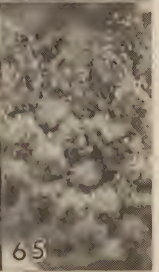
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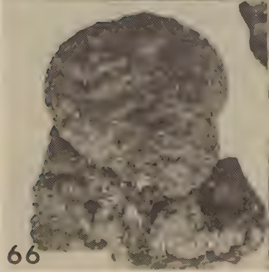
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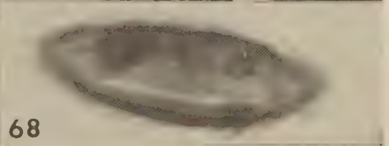
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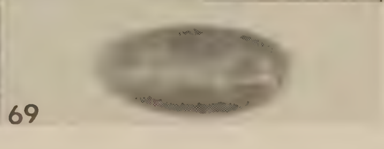
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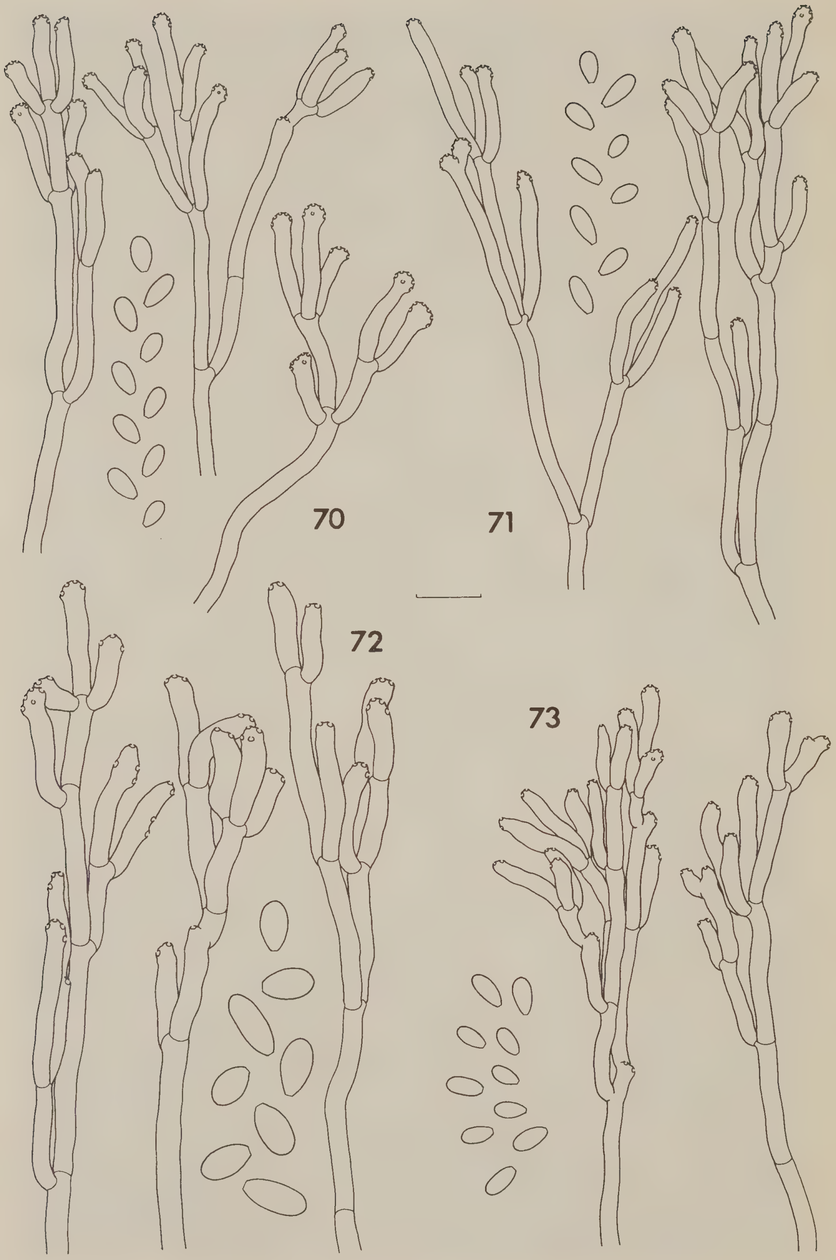

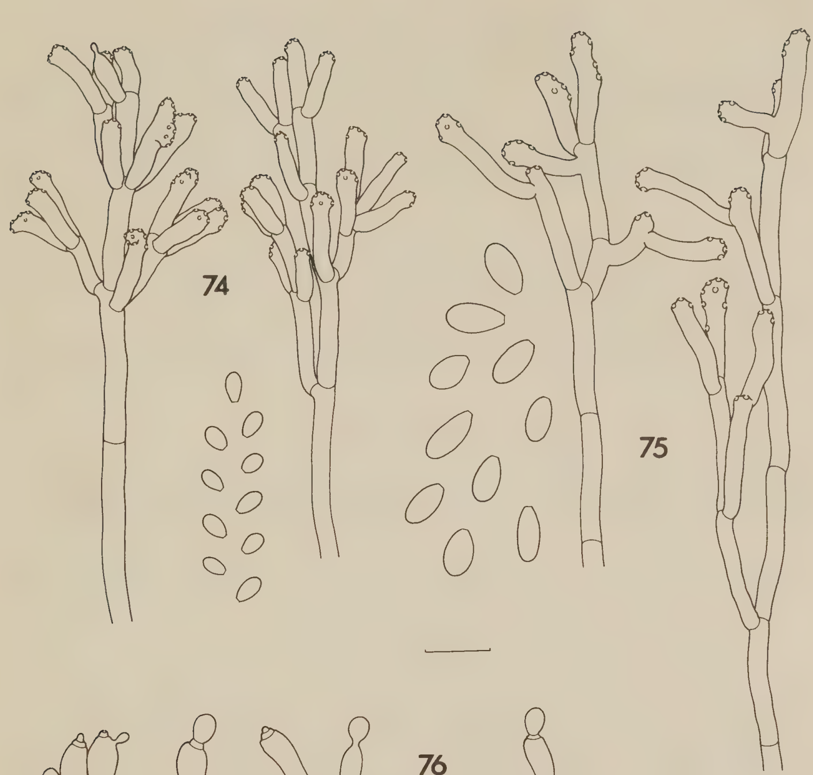
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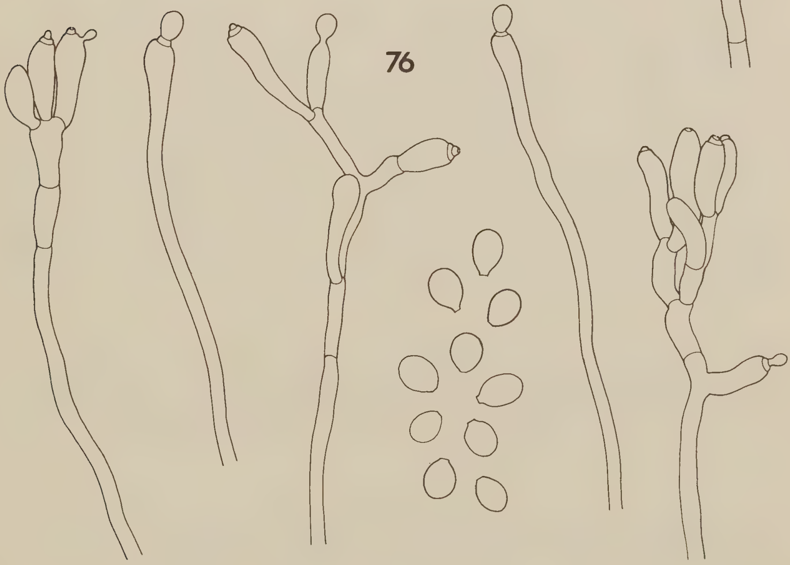
76

MYCOTAXON

Volume LXI, pp. 295-301 January-March 1997

AMPLIFIED DESCRIPTION AND LECTOTYPIFICATION OF PORONIA EHRENBERGII (XYLARIACEAE, HYMENOASCOMYCETES)

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SUMMARY

Poronia ehrenbergii Henn. is reported from the southern hemisphere for the first time. An amplified and first English description of the fungus is provided and a lectotype is designated.

KEY WORDS: amplified description; lectotypification; new record; *Poronia ehrenbergii*.

INTRODUCTION

The pyrenomycetous fungus *Poronia ehrenbergii* Henn. was originally described by Hennings (1893a) from material collected by Ehrenberg in Arabia, and was only recorded again some 36 years later from the Sultanate of Obbia, Somalia by Mattirolo (1929). To the best of our knowledge no other collection of this fungus has been reported in the literature. Although Dennis (1958) accepted *P. ehrenbergii* as a valid species [as *Xylosphaera ehrenbergii* (Henn.) Dennis], he did not examine any material and merely referred to the earlier reports of Hennings and Mattirolo. An excursion to the Giribes plain in Kaokoland, north-western Namibia (Fig. 1a), to study the peculiar bare patches occurring there (Theron, 1979; Eicker *et al.*, 1982), yielded an unexpected bonus, therefore, when *P. ehrenbergii* was discovered growing in sandy soil on the verge of one of the patches. As far as could be ascertained, the Namibian collection represented the fifth only known find of this rarely collected fungus and, together with an earlier unrecorded collection from Angola, greatly extended its distribution into the southern hemisphere. More recently, *P. ehrenbergii* was also found in southern Zimbabwe.

In the absence of anything more substantial than the brief original Latin description (Hennings, 1893a), which also appeared, unchanged, in a second journal later that same year (Hennings, 1893b), an amplified description of the fungus and brief remarks on its habitat are provided. A lectotype is also designated.

MATERIALS AND METHODS

Only six collections of *P. ehrenbergii*, comprising a total of twenty-three dried specimens, are known to exist and the description that follows is based on a study of all six of those collections. The Namibian material, comprising four specimens (Fig. 1d), was obtained from the South African National Collection of Fungi (PREM), and the Zimbabwean collection, comprising a single specimen only (Fig. 1e), from the Forestry Research Centre herbarium in Harare, Zimbabwe. The Erbario Tropicale di Firenze (FT) kindly made available Mattirolo's Somalian material consisting of two intact specimens and fragments of a third (Fig. 1c), while the herbarium of the Royal Botanic Gardens at Kew (K) supplied on loan both collections in its possession, one from Angola consisting of two specimens, and a large collection of twelve specimens from Pakistan. A single extant specimen of Ehrenberg's original Arabian collection was traced to the Swedish Museum of Natural History, Stockholm (S). Herbarium abbreviations are according to Holmgren *et al.* (1990).

For light microscopy, hand sections and squash preparations of the African and Pakistani material were mounted in clear lactophenol, lactophenol/aniline blue or Meltzer's reagent and observed through a Reichert-Jung Polyvar microscope. The same microscope was also adapted for stereo microscopy by using two Fi L151 illuminators (Fiberoptic-Heim AG), each equipped with two flexible optical fibre light conductors.

DESCRIPTION

Poronia ehrenbergii P. Hennings, Bot. Jahrb. Syst. 17: 5-6 (1893).
≡ *Xylosphaera ehrenbergii* (P. Hennings) Dennis, Revta. Biol. Lisb. 1: 207 (1958).

Stromata solitary, non-carbonaceous, stipitate, mostly simple, seldomly dichotomously forked, 11-238 mm long, with only about 7-25 mm protruding above soil level. The above-ground part expanding into a funnel- to trumpet-shaped fertile discoid head. Radial cracks on the exterior surface (Hennings, 1893a, b) prominent on the Arabian and Pakistani specimens only. Disk roundish, oval or heart shaped in surface view, 2-9 x 3-14 mm across, concave with a pronounced raised ridge along the periphery, upper surface pure white, smooth to the unaided eye but floccose under magnification, dotted with numerous black perithecial ostioles, the latter absent from the raised rim. In cross section the disk is composed of creamish-white prosenchymatic tissue consisting of aseptate, unbranched, hyaline hyphae ca. 3 µm in diam., with walls ca. 1 µm thick. Stipe usually tapering down from the apical disk to a diameter of about 1-2 mm some distance below the soil line, then gradually expanding to 3-5 mm before tapering again to ca. 2 mm diam., greyish black externally, white internally. Above-ground section covered to a more or lesser degree by a whitish to ochraceous velvety tomentum, subterranean section encrusted with sand granules caught between cottony dematiaceous hyphae visible at 40x magnification. Perithecia confined to the concave stromatal apex and completely immersed in the apical disk, not protuberant, oval, ca. 870-980 µm x 600-800 µm. Perithecial wall black when dry, reddish brown in Meltzer's reagent or colourless lactophenol, consisting of 2-3 layers of differing texture and colour intensity. Asci 8-spored, hyaline, 95-180 µm in length, on persistent stalks up to 12.5 µm long, more or less cylindrical when empty, otherwise wider nearer the base (22.5-40 µm) than at the apex (17.5-25 µm), apices broadly rounded to truncate (when truncate, a small dome shaped protrusion may be present, protruding beyond the flat apical surface, visible in Meltzer's reagent). Ascus tip apparatus prominent, blueing in Meltzer's reagent, doughnut-shaped in surface view, in side view resembling a hollow cylinder, tapering towards the apex in the case of the Somalian material, or, in the case of the Namibian material, appearing to consist of two zones resembling an upside-down cup

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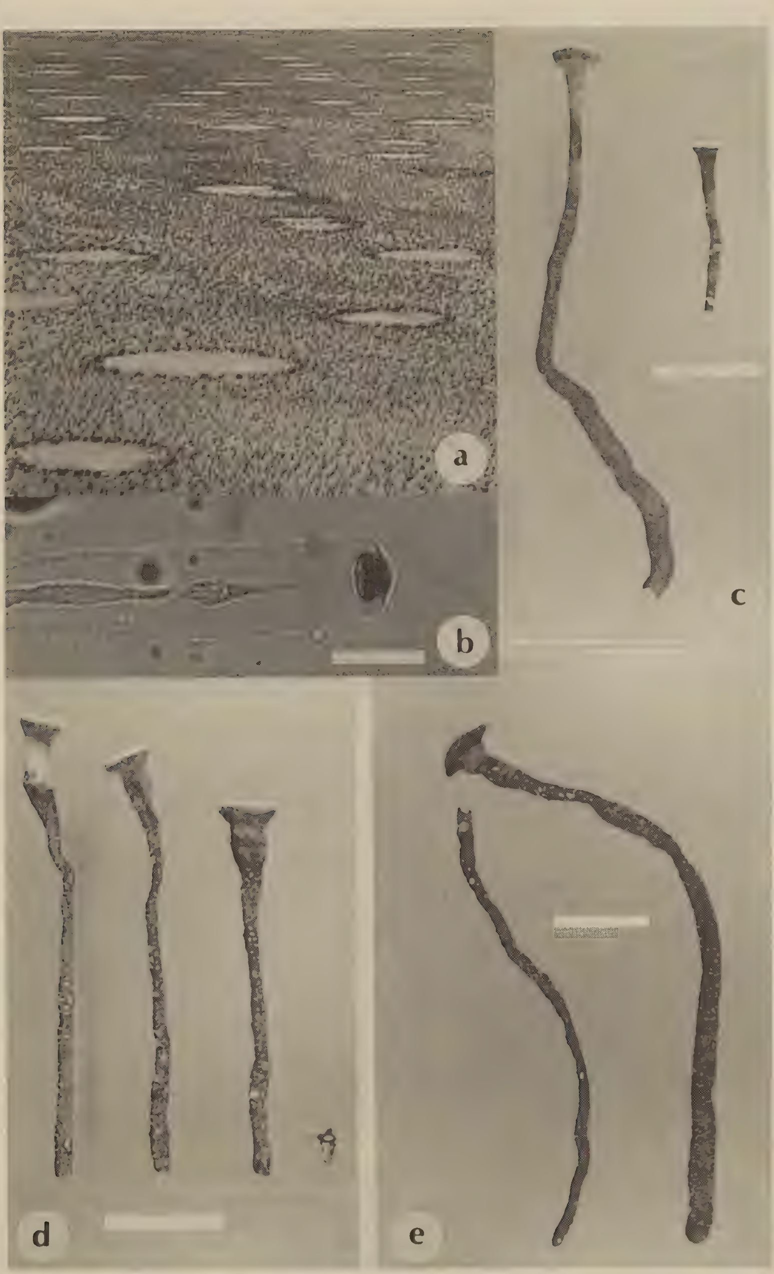
Fig. 1. a. View of the Giribes plain, Namibia. b. Cup and saucer-shaped ascal apical tip apparatus, Namibian specimen. c-e. *Poronia ehrenbergii* from Somalia, Namibia and Zimbabwe, respectively. Scale: Bar on b = ca. 20 µm. Bar on c-e = 2 cm.


a
b
c
d
e

and saucer (Fig. 1b), with the "cup" often appearing more intensely stained than the more apically situated "saucer". The tip apparatus of the Angolan, Pakistani and Zimbabwean specimens seem to be intermediate between that of the Namibian and Somalian material: "cup and saucer" tips occur, but bowl-shaped tips predominate, with the "bowl", which appears to consist of a number of stacked rings, approaching in form the tapering cylinder-shaped tips of the Somalian material. Ascospores ellipsoidal to oval, the one side often appearing less convex than the other, more rarely slightly kidney-shaped, 15-29.4 x 25-51.3 µm, uni- or biseriately arranged, occasionally irregularly clustered together near the base of the ascus, unicellular, smooth, hyaline at first, becoming light ochraceous and eventually very dark reddish brown at maturity, equipped with a germ slit running ca. 0.37-0.5 the length of the spore, aguttulate or with numerous tiny vacuoles at first, but prominently uniguttulate at maturity, surrounded by a thin, hyaline sheath and with a large, almost spherical, hyaline slime body at each pole, better visible in lactophenol/aniline blue than in Meltzer's reagent, and quite reminiscent of the winged extensions of *Pinus* pollen. Anamorph not observed, but according to Hennings (1893a, b) the conidia are hyaline, globose, 3-5 µm.
Habitat: Sandy soil in arid areas.
Distribution in Africa: South-western Angola; north-western Namibia; south-eastern Zimbabwe; central Somalia.
Distribution elsewhere: Arabia, central Pakistan.
Icones: Hennings (1893a), Lloyd, (1920), Dennis (1958).
Material examined: ARABIA: Ehrenberg s.n., S, s.n. "ex Herb. Sydow." Isotype. PAKISTAN: Dagar Kotli, 22 miles from Bhakkar, in sandy soil, attached to rootlets of *Pennisetum divisum*, S. Ahmad 27177, K, s.n., 20 November 1976. ANGOLA: Pediva, 48 miles E.S.E. of Porto Alexandre (now Tombua), in open grass veld on sand, J. Balfour-Browne s.n., K, Flora of Angola s.n., 26 June 1954. NAMIBIA: Giribes plain, Kaokoland, on sandy soil, J.C. Coetzee s.n., PREM 45929, April 1979. SOMALIA: Sultanate of Obbia: in the vicinity of Dablarrór, collector unknown, FT 3586.1, 3 May 1924. ZIMBABWE: Gonarezhou National Park, on ground in *Guibourtia* sandveld, C. Sharp (CH 121), Forest Research Centre Herbarium, Harare, no 1730, 20 April 1983.

SYSTEMATIC POSITION

The non-carbonaceous stroma, *Poronia*-like, flaring, discoid fertile head, long, felty, subterranean stipe, large ascospores and non-coprophilous habit characterise this species.

According to Dennis (1957) some borderline fungi make it extremely difficult to separate *Poronia* Gray from *Xylaria* Hill ex Schrank unless the coprophilous habit of *Poronia* is stressed. Dennis (1958) therefore transferred the non-coprophilous *P. ehrenbergii* to *Xylosphaera* Dumort. [= *Xylaria* Hill ex Schrank, *nom. cons.*]. More recently, however, authors such as Boise (1982), Morgan-Jones & Hashmi (1973), Rogers (1985) and Stiers *et al.* (1973) have questioned this emphasis on the growth substrate, believing that anamorphic criteria might be more decisive in separating *Poronia* from *Xylaria*. We tend to share this view and believe that any decision to transfer this fungus to *Xylaria*, unsubstantiated by anamorphic evidence, might be premature. Based on morphological criteria, in particular the non-carbonaceous nature of the stroma equipped with a cupulate fertile portion as emphasised in the keys of Lloyd (1919) and Barr (1990), we prefer to retain this fungus in the genus *Poronia* until the opportunity to study its anamorph arises.

Microscopically, the Somalian and Namibian specimens differed with regards to the shape of their ascal tip apparatus, observed as being tapering cylindric in the former and "cup and saucer"-shaped in the latter. The Angolan and Zimbabwean collections, however, exhibited not only the "cup and saucer" type but also a more or less bowl-shaped tip apparatus, intermediate between the Namibian and Somalian material.

Because of this intermediate form, and especially in view of the small number of specimens available for study, we are hesitant to ascribe too much taxonomic significance to the observed difference in ascal tip morphology at this stage.

LECTOTYPIFICATION

Ehrenberg's Arabian collection which served as basis for Henning's description of *P. ehrenbergii* had been deposited at B (Hennings, 1893b), but a holotype was not designated (Hennings, 1893a, b). It is not known how many specimens the Ehrenberg collection consisted of, but the entire collection at B was destroyed by fire during World War II (Dr. B. Hein, Curator: Botanischer Garten und Botanisches Museum Berlin-Dahlem, pers. comm.). Our search for extant specimens of the original material brought to light, however, that a single specimen from the Ehrenberg collection [not the one illustrated in Hennings (1893a) and Dennis (1958), nor the one photographed by Lloyd (1920)] found its way into the Sydow herbarium which, in turn, was acquired by S in 1919. This acquisition was most fortunate since Sydow's subsequent collections were also destroyed during the war (Stafleu & Cowan, 1986). The specimen ex Herb. Sydow in S is not numbered, but the containing envelope bears the following inscription in what appears to be Paul Sydow's handwriting (cf. Burdet, 1978, p. 423 c): "Poronia Ehrenbergii P. Henn. Arabien. leg. Ehrenberg. Original!". The specimen had, unfortunately, been pressed, with the two halves of the disk surface folded together, obscuring the surface and perithecial ostioles. A single ascospore, typical of *P. ehrenbergii*, found on the exposed disk edge, was the only reproductive structure observed. However, in order not to damage the specimen, no perithecial dissection was done. The very characteristic macroscopical features did not necessitate this, however, and, despite the shortcomings of the specimen, there can be no doubt as to its identity.

To the best of our knowledge this isotype in S represents the only extant original material of *P. ehrenbergii* and it is therefore here designated as lectotype in accordance with articles 9.2 and 9.9 of the ICBN (Greuter *et al.*, 1994).

HABITAT

With the exception of the Zimbabwean collection, all the localities from which *P. ehrenbergii* has been reported have an annual precipitation of 250 mm or less (Fullard *et al.*, 1981).

Neither Hennings (1893a, b) nor Mattirolo (1929) mentioned the substrate or ecological conditions under which *P. ehrenbergii* occurred. The Angolan, Namibian, Pakistani and Zimbabwean collections, however, support Saccardo's (1895) citing of the substrate as sandy soil, and the nature of the soil particles encrusted on the stipe of the Somalian material seems to indicate that it too occurred in sandy soil. From the little information available at this stage, it would thus seem that this fungus has a predilection for relatively arid areas with sandy soils.

Our own speculation that *Poronia ehrenbergii* obtains nourishment from buried plant matter has been substantiated by the Pakistani collection which, according to the herbarium label, was found attached to rootlets of the desert grass species *Pennisetum divisum* (Forssk. ex Gmel.) Henr.

The Giribes plain where the Namibian collection was made is situated in the southern part of Kaokoland, approximately 25 km west of the settlement of Sesfontein, in the north-western corner of Namibia. The area consists of an almost treeless grassland, dotted with peculiar circular patches devoid of vegetation and averaging about 6 m diameter (Fig. 1a). The mean annual rainfall in the area varies between 100-

150 mm, occurring mostly from mid-summer to autumn. The soil is generally deep, consisting of a coarse sand with eutrophic properties, belonging to the Hutton form, Moriah series. Between the bare patches, *Stipagrostis uniplumis* (Licht.) De Winter is the dominant grass species, with the taller *Stipagrostis giessii* Kers occurring along the verges of the patches (Theron, 1979). *P. ehrenbergii* grew in association with these two grass species, and although nourishment is probably derived from the dead roots of these plants, digging failed to reveal any direct evidence to this effect.

ACKNOWLEDGEMENTS

We are deeply indebted to the curators of the Swedish Museum of Natural History (S), the South African National Collection of Fungi (PREM), the Erbario Tropicale di Firenze (FT), the herbarium of the Royal Botanic Gardens, Kew (K), and the herbarium of the Forest Research Centre in Harare, Zimbabwe, for entrusting us with valuable study material. Valuable information was also received from B, BPI, BR, C, FH, H, KIEL, L, PAD, SRGH, WIND, Z & ZT, as well as Dr. Kathy Jacobson of the Desert Ecological Research Unit of Namibia.

Dr. P.W. Crous of the University of Stellenbosch is thanked for his critical review of an earlier draft of this manuscript. This work was partially funded by a FRD grant to the junior author.

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MYCOTAXON

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BAHUSUTRABEEJA BUNYENSIS SP. NOV. (HYPHOMYCETES) FROM QUEENSLAND, AUSTRALIA, AND A NEW NAME FOR CHALARA AUSTRALIS McKENZIE

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Introduction

During a visit to the Bunya Mountains National Park rainforest in south-east Queensland, Australia, some dead, attached stems of the shrubby climber *Ripogonum album* R. Br. were collected. One sample yielded an abundant collection of a new species of *Bahusutrabeeja*, which is described below.

McKenzie (1993) described a new *Chalara* species on leaf litter of *Dracophyllum arboreum* Cockayne, from the Chatham Islands, New Zealand. Unfortunately the name chosen, *C. australis*, is a homonym of *C. australis* Kile & J. Walker (1987). A new name is proposed.

Bahusutrabeeja bunyensis McKenzie sp. nov. Fig. 1.

Conidiophora macronematosa, mononematosa, solitaria, eramosa, erecta, recta vel paulo flexuosa, laevia, septata, atro rubro-brunnea, apicem versus pallidiora, usque ad 210 µm longa, ad basim 5.5-6.5 µm lata, ad apicem 3.5-4 µm. Cellulae conidiogenae monophialidicae, in conidiophoris incorporatae, terminales, cylindricae, usque ad 60 x 3.5-4 µm, brunneae, pallide brunneae ad apicem, partim verrucosae; collum obconicum, usque ad 2.5 x 1.5-2 µm. Conidia in massis globosis aggregata, hyalina, globosa vel subglobosa, eseptata, 7.5-10.5 x 7.5-9.5 µm, laevia; cytoplasmate granuloso; 3-setulosis, filiformes, hyalinae, eseptatae, 5-9 µm longae.

In caulibus mortuis smilacaceae speciei *Ripogonum album* R. Br.
Holotypus BRIP 23211, isotypus PDD 65196.

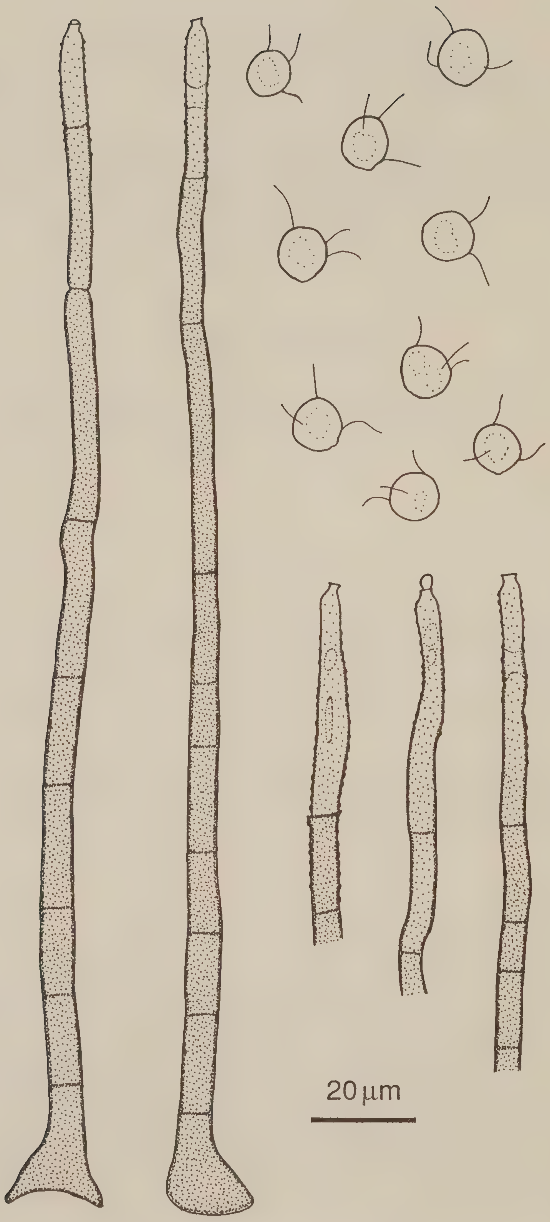

Figure 1. *Bahusutrabeeja bunyensis*, conidiophores and conidia of type (BRIP 23211) from host.

Conidiophores macronematous, mononematous, single, unbranched, erect, straight or slightly flexuous, smooth, septate, dark reddish brown, paler towards the apex, up to 210 µm long x 5.5-6.5 µm near the base, tapering to 3.5-4 µm diam. near the apex. Conidiogenous cells monophialidic, integrated, terminal, cylindrical, up to 60 µm long x 3.5-4 µm wide, brown, pale brown at apex, verrucose for part of their length, with a prominent, thin-walled, slightly flared collarette, up to 2.5 µm deep x 1.5-2 µm wide; sometimes proliferating through the collarette. Conidia aggregated in slimy, white, glistening heads, hyaline with granular cytoplasm, globose to subglobose, nonseptate, 7.5-10.5 x 7.5-9.5 µm, smooth, with 3 filiform, hyaline, nonseptate appendages 5-9 µm long.

On dead attached stem of *Ripogonum album* R. Br.
Specimen examined: Australia, Queensland, Bunya Mountains National Park, near Westcott Plain, 23 Nov 1995, E.H.C. McKenzie (BRIP 23211 - holotype; PDD 65196 - isotype).

The specific epithet refers to the locality where the specimen was collected.

To date, three species of *Bahusutrabeeja* have been described. One of these, *B. angularis* V. Rao & de Hoog, has conidia of a similar size to those of *B. bunyensis*, but they are angular in shape with 3-5 short appendages, each up to about 4 µm long (Rao & de Hoog 1986). The other two species have larger, spherical conidia with more appendages. The type species, *B. dwaya* Subram. & Bhat, has conidia 12-19 µm diam. with 8-16 appendages (Subramanian & Bhat 1977), while *B. globosa* Bhat & W.B. Kendr. has conida 18-22 µm diam. with 9-12 appendages (Bhat & Kendrick 1993). Features useful for distinguishing the four species of *Bahusutrabeeja* are summarised in Table 1.

Table 1: Some distinguishing features of the four known *Bahusutrabeeja* species.

Species	**Collarette**	**Conidia**	**Conidial appendages**	
			Number	**Length**
B. angularis	well developed	angular, 7-8 µm	3-5	up to 4 µm
B. bunyensis	well developed	spherical, 7.5-10.5 µm	3	5-9 µm
B. dwaya	inconspicuous	spherical, 12-19 µm	8-16	4.5-12 µm
B. globosa	inconspicuous	spherical, 18-22 µm	9-12	6.5-12.5 µm

On agar culture the first-formed conidium of *B. dwaya* is pyriform (Subramanian & Bhat 1977). Later-formed conidia appear to have a slightly projecting base, as figured by Kuthubutheen et al. (1992). Conidia of *B. angularis* have a slightly projecting, truncate base, as do those of *B. bunayensis*.

To compare conidial morphology with that observed by Rao & de Hoog (1986) for *B. angularis*, the present species was mounted and examined in both hydrous lactophenol and 3% KOH. The mountant had no effect on conidial morphology or size, affecting only the appearance of the cytoplasm.

The three previously known species were all described on dead twigs or leaves from India. Kuthubutheen et al. (1992) have recorded a second collection of *B. dwaya* on decaying twigs in a stream, in Malaysia.

Chalara dracophylli McKenzie nom. nov.
≡ *C. australis* McKenzie, *Mycotaxon 46*: 291, 1993
non *C. australis* Kile & J. Walker, *Australian Journal of Botany 35*: 7, 1987

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MYCOTAXON

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CHAETOSPHAERULINA BAMBUSAE SPEC. NOV. (PLEOSPORALES) FROM INDIA

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During examination of fungi occurring on bamboo, the authors came across an interesting species with dark colored, appendaged, ostiolate pseudothecia producing bitunicate asci and elongate fusoid, hyaline ascospores. The saprobic habit, presence of hyphal appendages on the soft, pseudoparenchymatous peridium, and nature of asci and ascospores led to the Tubeufiaceae. A search for the genus to house this fungus discarded *Acanthophiobolus* because of its scolecosporous ascospores that are spirally arranged in the cylindric ascus and its vestiture of both setae and basal hyphae. *Chaetosphaerulina yasudae* Hino, the type species of that genus, develops on dead culms of bamboo and has hyphal appendages. A second species, *C. vermicularispora* Hino & Katumoto was also described from bamboo in Japan. Pirozynski (1972) reduced the genus to synonymy under *Herpotrichia*, and transferred the two species to that genus. This disposition was accepted by Erikson & Hawksworth (1987) and Rossman (197). *Herpotrichia* is arranged in the Lophiostomataceae. The families differ in habit, position and shape of ascomata, peridium structure, type of vestiture, and ascospore shape, pigmentation, and septation. Sivanesan (1984), on the other hand, indicated that *Chaetosphaerulina* was synonymous with *Tubeufia* and assigned the two species to that genus. The species of *Tubeufia* in the narrow sense are pallid or brightly pigmented, without elongate hyphal appendages or setae.

Subramanian and Sekar (1980) described a collection as *C. yasudae* from South India. They suggested the *Chaetosphaerulina* should be reinstated. However, Sivanesan (1983) redescribed this collections *Thaxteriellopsis bambusicola* Sivanesan & N.D. Sharma, in which longitudinal as well as transverse septa form in the ascospores. We too believe that *Chaetosphaerulina* should be reinstated to include species in the Tubeufiaceae whose dark pseudothecia are clothed by septate, hyphal appendages and whose asccospores are transversely septate. The shapes of pseudothecia differ from those of the described species. A detailed description and drawings present a new species of *Chaetosphaerulina* from Central India.

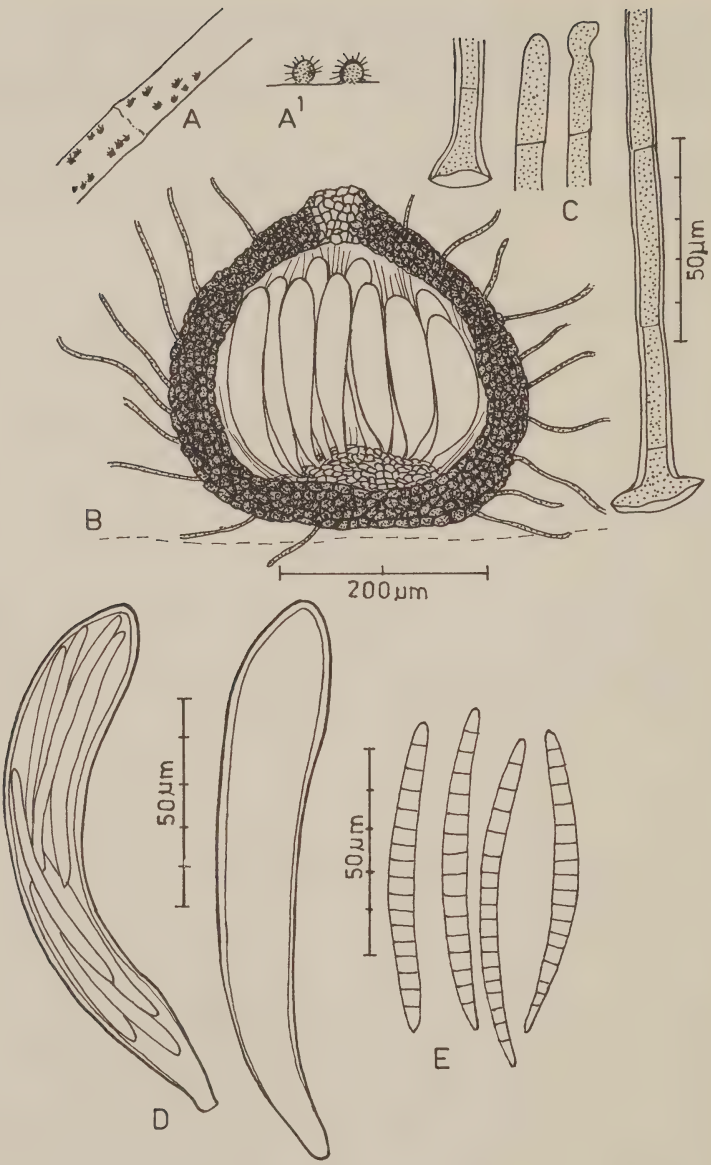
A
A1
C
50µm
B
200µm
50µm
50µm
D
E

Fig. 1. *Chaetosphaerulina bambusae*

A, A^1: Habit; B: Pseudothecium in v.s.; C: Appendages-basal & apical parts; D: Asci; E: Ascospores.

Chaetosphaerulina bambusae A. Pande & V.G. Rao sp. nov. (Fig. 1)

Pseudothecia superficialia, solitaria et sparsa, globosa, nigra, setosa, ostiolata, 240-500 µm diam.; appendiculae hyphae brunneae, septatae, crassiusculatae; brevae magnit. 100-130 x 4-6 µm, et longae magnit. 160-280 x 4-6 µm. Asci clavati, brevistipitati vel sessilis, octospori, bitunicati, 120-140 x 18-25 µm; ascosporae 8, hyalinae, fusoideae vel elongatae, transverso-multiseptatae, 80-100 x 4-8 µm.

Collecti in caulis emortiae *Bambusa bambos* (L.)Voss. ad loco Nagzira (M.S., India) dt. 24.XII.1994 ; leg. B.R. Kakade; positus ad Herb. subnumero AMH 7917 (Holotypus) et AMH 7918.

Pseudothecia superficial, globose, separate, ostiolate, slightly papillate, 240 - 500 µm in diam., black, covered with black to dark brown hyphae appendages; wall 20-30 µm thick, composed of brown to dark brown, thick-walled cells. Papilla and the ostiolar region with smaller and lighter cells. Hyphal appendages arising from dark brown cells in the ascocarpic wall, thick walled, brown to black, lighter colored at the tip, septate, 4-6 µm wide; length variable from 100 - 130 µm for shorter appendages and 160 - 280 µm for longer appendages. Asci clavate, shortly stalked or sessile, bitunicate, octosporous, produced from the base, intermixed with thin, hyaline pseudoparaphyses; 120 - 140 x 18-25 µm. Ascospores 8, hyaline, elongate fusoid, transversely multiseptate, often breaking at the central septum, arranged in two fascicles, a slightly twisted manner in the asci; 80 - 100 x 4 - 8 µm.

Collected on stems of *Bambusa bambos* at Nagzira (Dist. Bhandara, Vidarbha, Maharashtra State, India); 24th December 1994; leg. B.R. Kakade; deposited under Herb. nos. AMH 7917 (Holotype) & AMH 7918.

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MYCOTAXON

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SPANISH HYPHOMYCETES XVI. SOME AERO-AQUATIC CONIDIAL FUNGI

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ABSTRACT

Five aero-aquatic conidial fungi were found colonizing decaying leaves and twigs of deciduous and coniferous plants submerged in ponds and streams in woodlands of Northern Catalonia, Spain. These *are Aegeritina tortuosa* (Bourd. & Galz.) Jülich, *Clathrosphaerina zalewskii* Beverwijk, *Pseudaegerita corticalis* (Peck) Crane & Schoknecht, *Spirosphaera floriformis* Beverwijk and *S. minuta* Hennebert. A brief description either from pure culture or from natural substrates is provided for each species. The reported species are new records to the Spanish mycobiota.

Keywords: Aero-aquatic fungi, Hyphomycetes, Spain.

RESUMEN

Se hallaron cinco especies de hongos conidiales aero-acuáticos pertenecientes a diversos géneros sobre restos de hojas, ramas de caducifolios y coníferas de distintos charcos y riachuelos en el Pirineo catalán, España. Las especies son *Aegeritina tortuosa* (Bourd. & Galz.) Jülich, *Clathrosphaerina zalewskii* Beverwijk, *Pseudaegerita corticalis* (Peck) Crane & Schoknecht, *Spirosphaera floriformis* Beverwijk y *S. minuta* Hennebert. Cada una de ellas se describe brevemente sobre el sustrato natural o en cultivo puro. Las especies son nuevas citas para la micobiota española.

Palabras Clave: Hongos aero-acuáticos, Hifomicetos, España.

INTRODUCTION

During a survey of aero-aquatic conidial fungi in static water habitats and streams in woodlands of the Catalan Pyrenees (Abdullah *et al.*, 1996a,b), some additional interesting species assigned to the genera *Aegeritina* Jülich, *Clathrosphaerina* Beverwijk, *Pseudaegerita* Crane & Schoknecht and *Spirosphaera* Beverwijk were encountered. All the species sporulated on decaying twigs and leaves of deciduous and coniferous plants collected from ponds and streams and incubated in moist chambers at 15ºC. The majority of species were obtained in pure culture. All the reported species represent new records to the Spanish mycobiota.

DESCRIPTIONS AND DISCUSSION

Aegeritina tortuosa (Bourd. & Galz.) Jülich, Int. J. Myc. Lich. 1: 282, 1984
Figs.1a-c.

Colonies white on the natural substrate, conidial propagules more or less globose, white in mass, 50-150 μm diam, consisting of twisted interwoven hyaline, monomitic hyphae, 2.0-2.5 μm wide, septate, thin-walled, with clamps. Cystidia elongated, subulate, up to 50 x 2-2.5 μm, projecting outwards from the centre of the conidial body, studded with crystal-like bodies (neck-tie-like) arranged in two longitudinal rows.

Specimen examined: FMR 5578, on unidentified decaying twig submerged in stream nr. Cantallops, Alt Empordà, N. Catalonia, Spain, 7 Nov. 1995, S.K. Abdullah.

The species was described by Bourdot & Galzin (1928) as *Aegerita tortuosa*. However, the type species, *Aegerita candida* Pers. ex Fr., is characterized by forming more or less white ovoid conidial propagules composed of centrifugally arranged septate hyphae, divided into progressively larger cells with clamps at all septa and ending with a broadly clavate apical cell. Moreover, *A. candida* is associated with *Bulbillomyces farinosus* (Bres.) Jülich and devoid of the characteristic cystidia of the genus *Subulicystidium* Parm., which is present in *A. tortuosa*. The latter species is often found associated with *Subulicystidium longisporum* (Pat.) Prim. (Bourdot & Galzin, 1928; Jülich, 1974, 1984). The present collection has smaller conidial propagules and less compact and thinner interwoven hyphae than those reported by Bourdot & Galzin (1928). The species is so far known from Europe and North America (Bourdot & Galzin, 1928; Jülich, 1974; Abdullah & Fisher, 1984; Michaelides & Kendrick, 1982).

Clathrosphaerina zalewskii Beverwijk, Trans. Br. Mycol. Soc. 34: 289, 1951
Fig. 1d

Colonies on 0.2% MEA white to yellowish white, attaining a diam of 6 mm in two weeks at 15ºC, mycelium immersed and superficial, hyaline, septate, branched, 1-2 μm wide; reverse yellowish white. Conidiophores micronematous, septate, 1.5-2 μm wide. Conidiogenous cells blastic. Conidia 20-35 μm diam, white in mass. The clathrate sphere consists of a system of repeatedly dichotomous branches whose tips bend towards each other and touch, forming hexagonal meshes, each mesh 5-6 μm diam.

Specimens examined: FMR 5579, on *Quercus* leaves submerged in stream, Cantallops, Alt Empordà, N. Catalonia, Spain, 7 Nov. 1995. S.K. Abdullah; FMR 5589, on *Salix* leaves submerged in small pond, Arriu de Bordius, Valley of Arán, 12. Nov. 1995. S.K. Abdullah.

Descals & Webster (1976) have shown that *C. zalewskii* is the anamorphic state of the discomycete *Hyaloscypha zalewskii* Descals & Webster. The fungus is very well documented from Japan (Tubaki, 1958), North America (Bärlocher *et al.*, 1978) and Europe (Beverwijk, 1951; Arnold, 1970; Descals & Webster, 1976; Abdullah & Webster, 1980).

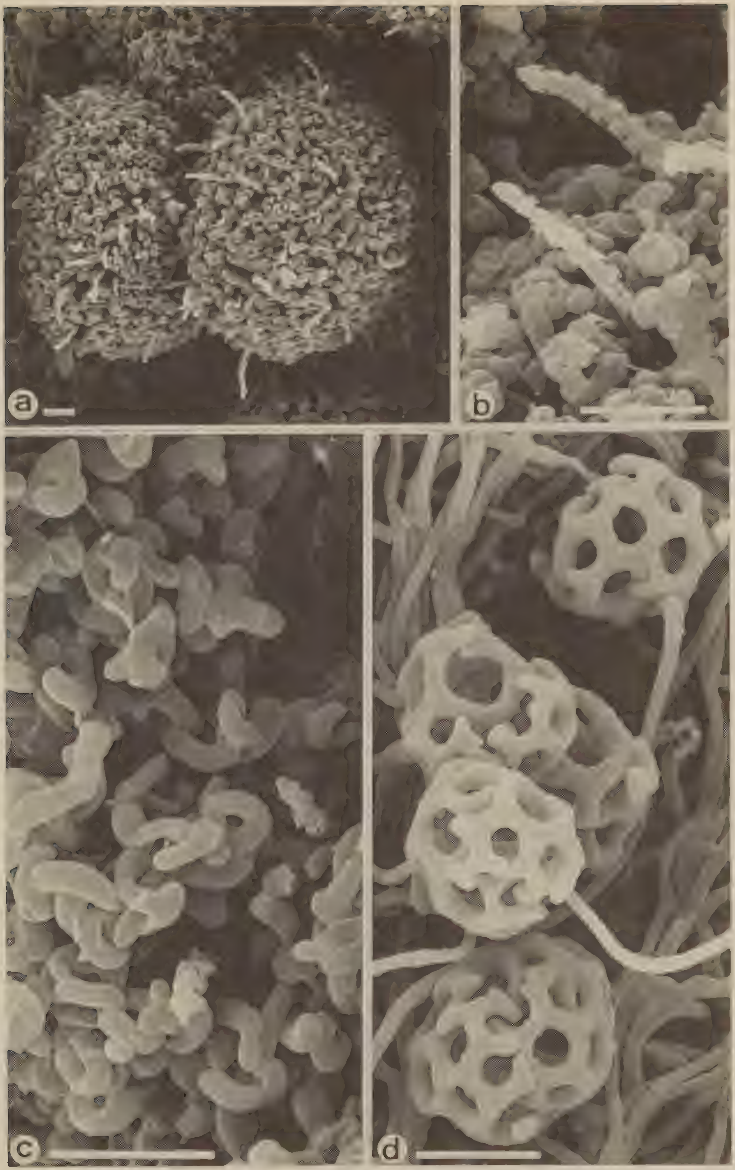

Fig. 1.- a-c, ***Aegeritina tortuosa***. d, ***Clathrosphaerina zalewskii*** (bar = a. 100 µm; b-d. 10 µm).

Pseudaegerita corticalis (Peck) Crane & Schoknecht, Mycologia 73: 79, 1981
Fig. 2a

Colonies on 0.2% MEA attaining 2 cm diam in two weeks at 15ºC; mycelium superficial and immersed, light brown, hyphae septate, 2.5-3.0 µm wide, thick-walled; colony reverse greyish brown to dark brown. Conidiophores semimacronematous, branched or unbranched, septate, light brown, up to 150 x 3-4 µm. Conidiogenous cells polyblastic, integrated. Conidial propagules spherical to subspherical, retaining air between the cells, 75-250 µm diam, white in mass at first, becoming brownish grey to greyish brown with age, composed of a branched system of broadly ellipsoidal cells 4-6 x 4-5 µm, each successively budding out 1-4 daughter cells. The conidial propagules float on water and easily break up into groups of cells.
Specimens examined: FMR 5581, on decaying *Salix* twig submerged in stream, Artiga de Lin, Valley of Arán, 13 Nov. 1995. S.K. Abdullah.

The genus *Pseudaegerita* was introduced by Crane and Schoknecht (1981) based on *Oidium corticale* Peck as the type. Abdullah & Webster (1983) enlarged the concept of the genus by adding two species, *P. viridis* (Bayliss Elliot) Abdullah & Webster, based on *Aegerita viridis* Bayliss Elliot (1918) and *P. matsushimae* Abdullah & Webster, based on *Papulaspora viridis* Matsushima (1975). The genus differs from *Aegerita* Pers. ex Fr. in forming conidial propagules lacking clamps. *Papulaspora* Preuss is restricted to fungi producing papulospores, which are small rounded propagules comprising one or more enlarged central cells surrounded by a sheath of smaller cells (Weresub & Le Clair, 1971). The species has been reported to be the anamorphic state of the Leotiaceous discomycete *Hyaloscypha lignicola* Abdullah & Webster (Abdullah & Webster, 1983). The species is so far known from the United States, Britain and Japan (Crane & Schoknecht, 1981; Abdullah & Webster, 1983; Abdullah *et al.*, 1986).

Spirosphaera floriformis Beverwijk, Trans. Br. Mycol. Soc. 36, 121 Fig.2b

Colonies on 0.2% MEA growing restrictedly, attaining a diam of 10-12 mm in two weeks at 15ºC; mycelium immersed and superficial, yellowish brown to dark brown, hyphae 3-4 µm wide septate, aerial mycelium slightly raised at the centre, margin consisting mainly of immersed mycelium, reverse brownish grey. Conidiophores macronematous, scattered or gregarious, septate up to 150 x 4-5 µm. Conidiogenous cells blastic. Conidial propagules varying in colour, white in mass at first then greyish brown to brown, globose to subglobose, up to 250 µm diam; consisting of interwoven filaments, each filament developed as a lateral branch on the parent filament, growing towards the centre, coiling and intertwining, then branching again in the same way. Filaments smooth, septate, constricted at septa, cells 7-10 x 3.5-6.0 µm.
Specimen examined: FMR 5582; on submerged decaying *Quercus* twig in stream, Cantallops, Alt Empordà, N. Catalonia, 7 Nov. 1995. S.K. Abdullah.
FMR 5583, on submerged decaying *Corylus* leaves, Arriu de Bordius, Valley of Arán, 12 Nov. 1995. S.K. Abdullah. FMR 5584, on submerged decaying *Pinus* twig. R. Ter, Vallter, nr. Setcases, N. Catalonia, 8 Nov. 1995. S.K. Abdullah.

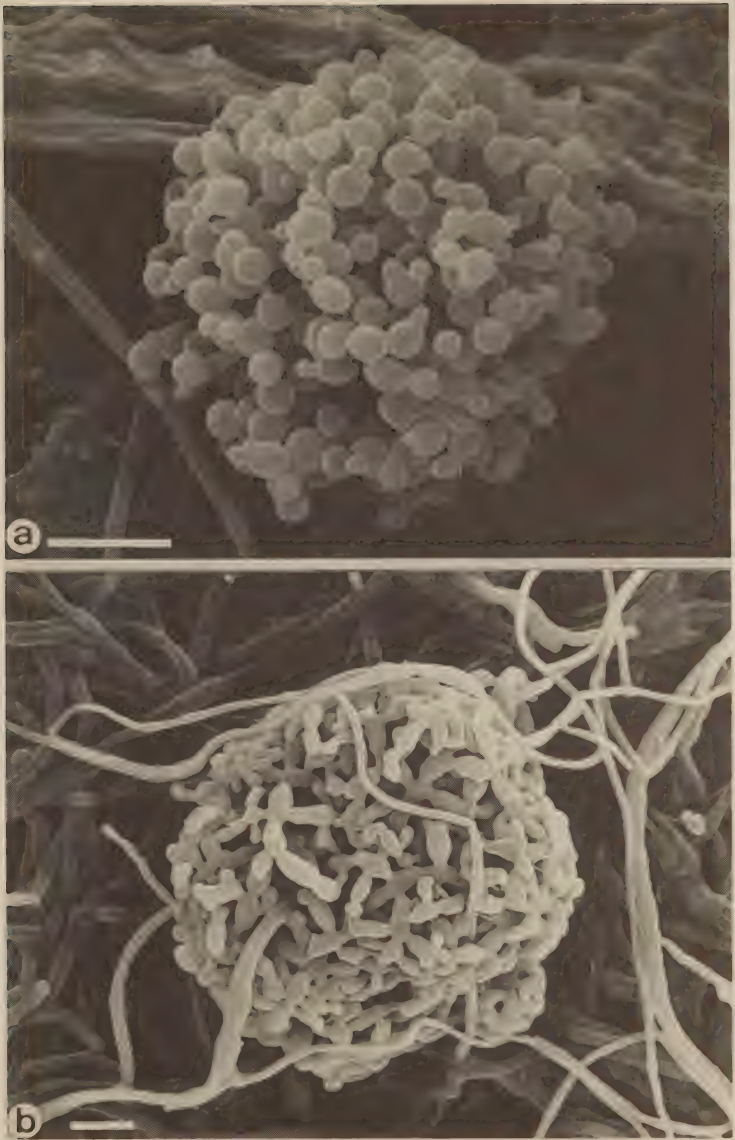

Fig. 2 - a, *Pseudaegerita corticalis* b, *Spirosphaera floriformis* (bar = 10 µm)

This is a very common species in Europe and has been reported from a variety of submerged decaying leaves and twigs in ponds and streams (Beverwijk, 1953; Hennebert, 1968; Arnold, 1967; Abdullah & Webster, 1980; Abdullah & Fisher, 1984). The fungus is also known from temperate North America (Michaelides & Kendrick, 1982).

Spirosphaera minuta Hennebert, Trans. Br. Mycol. Soc. 19, 1968 Fig. 3

Colonies on 0.2% MEA, yellowish white to pale yellow, growing slowly, attaining a diam of 2-3 mm in two weeks at 15ºC, mycelium immersed and superficial, septate, 1.5-2.0 µm wide; reverse pale orange to greyish orange. Conidiophores micronematous, up to 50 µm long. Conidiogenous cells blastic. Conidial propagules are loose balls, white in mass, 12-30 µm diam, composed of loosely interwoven filaments in 2-4 spirals, 5-10 µm diam. Filaments smooth, septate, knobbly on the periphery, 1.5-2 µm wide.
Specimen examined: FMR 5585; on submerged decaying *Corylus* leaves in small pond, Artiga de Lin, Vall of Arán, N. Catalonia. 13 Nov. 1995, S.K. Abdullah.

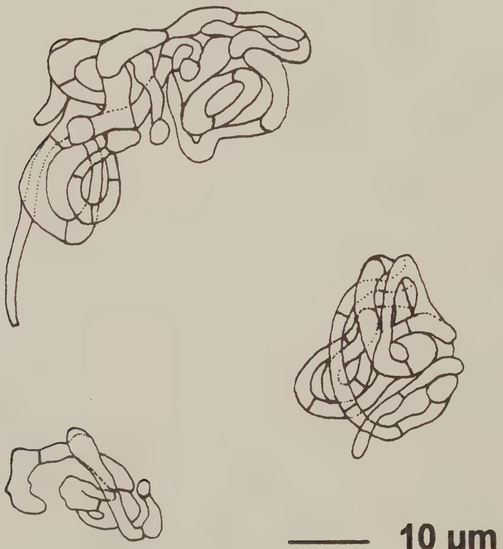

Fig. 3.- *Spirosphaera minuta* (bar = 10 µm).

S. minuta can be easily distinguished from other members of the genus (Hennebert, 1968; Abdullah *et al.*, 1986) as it has the smallest conidial propagules. Furthermore, the conidial filaments of *S. minuta* are 1.5-2.0 µm wide and knobbly at the periphery while filaments in other *Spirosphaera* species are wider and regular or slightly constricted at the septa. The species is so far only known from Europe (Hennebert, 1968, Abdullah, 1980). The species may have a wider distribution and is perhaps missed due to the minute size of its conidial propagules.

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NOTES ON CONIDIAL FUNGI. XI. TWO NEW SPECIES OF *CHEIROMONILIOPHORA* AND *ONCOPODIUM*

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ABSTRACT

Cheiromoniliophora gracilis anam. sp. nov. distinguished by flattened, compact, pale brown, palmate conidia and *Oncopodium paspali anam. sp. nov.* characterized by clavate conidiophores and ellipsoid, globose, hemispherical to cerebriform conidia, are described and illustrated. A key to species of *Oncopodium* is proposed.

Keywords: *Cheiromoniliophora, Oncopodium,* tropical fungi, hyphomycetes, systematics, leaf litter, Cuba.

RESUMEN

Se describen e ilustran *Cheiromoniliophora gracilis anam. sp.nov.* reconocible por sus conidios aplanados, compactos, de color parduzco y palmiforme y *Oncopodium paspali anam. sp. nov.* caracterizada por sus conidióforos claviformes y sus conidios elipsoides, globosos, de hemisféricos a cerebriformes. Se propone una clave dicotómica para la identificación de las especies de *Oncopodium.*

Palabras clave: *Cheiromoniliophora, Oncopodium,* hongos tropicales, hyphomycetes, sistemática, hojarasca, Cuba.

Cheiromoniliophora gracilis Castañeda Ruíz, Guarro *et* Cano *anam. sp. nov.*
Figs.1,2

Etym.: L. *gracilis* referring to the beauty of the conidia.

Ad fungus conidiales, Hyphomycetes pertinens. Coloniae effusae, amphigenae, leniter gossypinae usque pilosae, brunneo-olivaceae. Mycelium partim superficiale et partim in substrato immersum, ex hyphis septatis, ramosis, echinulatis, subhyalinis vel hyalinis, 2 µm diam, compositum. Conidiophora conspicua, mononematosa, fasciculata, erecta, septata, ramosa, usque 260 µm alta et 3.5 - 5 µm crassa ad basim, leniter inflata ad septos, subhyalina, typice echinulata ad basim, levia supra. Cellulae conidiogenae monoblasticae, raro sympodiales, terminales, postea intercalares, laeves, discretae, clavatae, interdum globosae, inflatae prope loco conidiogeno, 8 - 10 x 2 - 5 µm; moniliformes, hyalinae. Conidia palmata, compacta, interdum ellipsoidea, solitaria, sicca, levia, pallide brunnea, 10 - 17 x 7 - 10 µm, cum 2 - 3 ramis parallelis, confertis, 2 - 4 septatis, composita, ex cellula basi deltatis oriunda. Teleomorphosis ignota.

Holotypus: INIFAT, C94/44, in foliis dejectis *Nectandra coriacea*, San Antonio de los Baños, "Las Yagrumas", Habana, Cuba, leg. R. F. Castañeda, 15 Feb.1994. Isotypus: MUCL 39184.

Conidial fungi, Hyphomycetes. Colonies spreading, amphigenous, slightly cottony to hairy, olivaceous-brown. Mycelium superficial and immersed. Hyphae septate, branched, echinulate, subhyaline to hyaline, 2 µm diam. Conidiophores differentiated, mononematous, fasciculate, erect, septate, branched, up to 260 µm long, 3.5 - 5 µm wide at the base, slightly constricted at septa, subhyaline, typically echinulate at the base, smooth above. Conidiogenous cells monoblastic, rarely sympodial, terminal, becoming intercalary, smooth, discrete, clavate, sometimes globose, inflated near the conidiogenous loci, 8 - 10 x 2 - 5 µm, moniliform, hyaline. Conidia cheiroid, sometimes ellipsoidal, solitary, dry, smooth, pale brown, 10 - 17 x 7 - 10 µm, composed of 2-3 parallel, crowded, 2-4 septate branches, arising from a deltate basal cell. Teleomorph unknown.

Holotype: INIFAT C94/44, on dead leaves of *Nectandra coriacea,* San Antonio de los Baños, "Las Yagrumas", Havana, Cuba, col. R.F. Castañeda, 15 Feb.1994. Isotype: MUCL 39184

Ch. gracilis resembles *Ch. elegans* Tzean & Chen (1990) in conidial morphology and conidiophore ramification but *Ch. elegans* has conidiophores composed of globose to subspherical cells and brown to dark brown conidia, 11.2 - 27.0 x 9.5 - 16.8 µm, whereas *Ch. gracilis* has conidiophores composed of clavate cells and smaller, pale brown conidia.

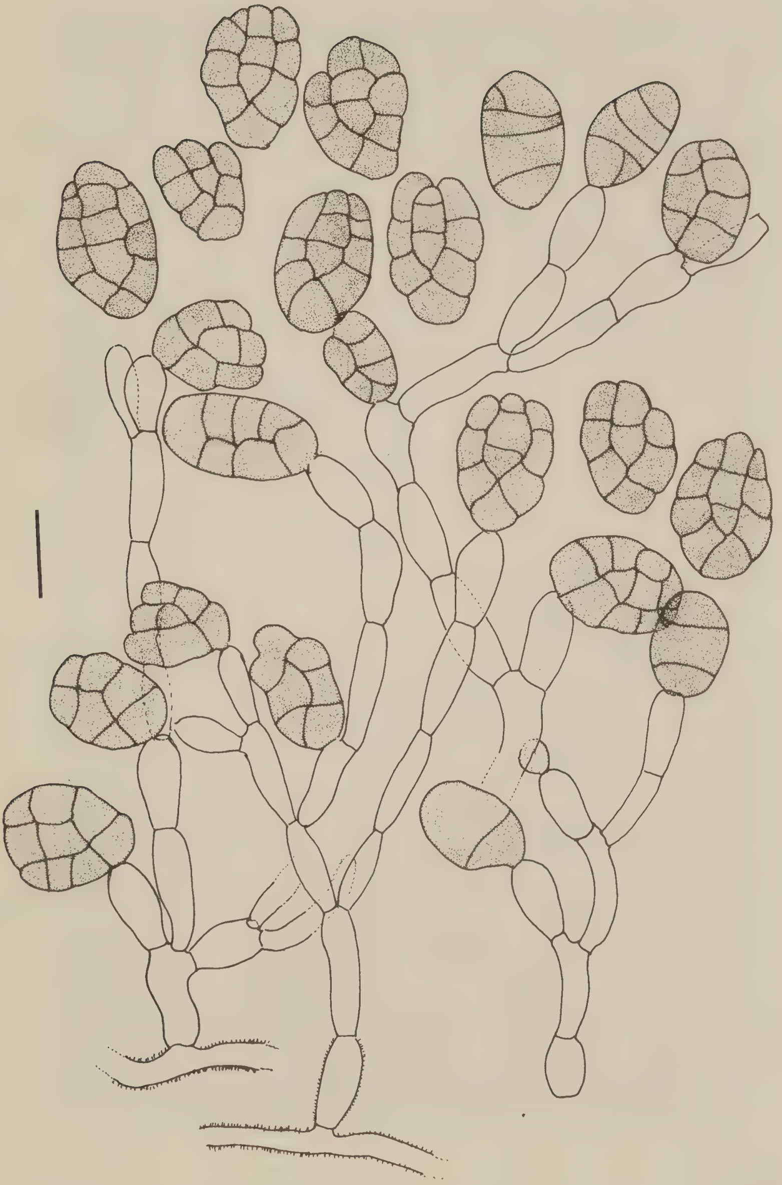

Fig. 1.- *Cheiromoniliophora gracilis* (INIFAT C94/44). Conidiophores, conidiogenous cells and conidia (bar = 10 µm)

Oncopodium paspali Castañeda Ruíz, Guarro *et* Cano *anam. sp. nov.* Figs.2,3

Etym.: L. *paspali*, referring to the plant genus from which the fungus was recovered.

Ad fungus conidiales, Hyphomycetes pertinens. Conidiomata sporodochialia, superficialia, dissita, hypophylla, punctiformia, nigra. Mycelium plerumque in substrato immersum, ex hyphis septatis, ramosis, subhyalinis vel hyalinis, laevibus, 2 - 2.5 µm diam, compositum. Stromata superficialia, primo incolorata, tarde brunnea, ex "textura angularis" composita. Conidiophora conspicua, numerosa, mononematosa, clavata, hyalina, levia, 25 - 32 x 7 - 10 µm, 3 - 4 µm crassa ad basim, interdum in cellulis conidiogenis compactis, reducta. Cellulae conidiogenae monoblasticae, terminales, determinatae, clavatae, incoloratae, leves, in conidiophoris incorporatae. Conidia crassa, ellipsoidea, globosa, hemisphaerica, usque cerebriformia, muriformia, irregularia ad marginem, cum cellulis centralis nigris, cellulis subcentralis brunneis et cetera subhyalinis vel hyalinis infra, solitaria, acrogena, sicca, 10 - 16 x 9 - 12 µm, plerumque in maturitate persistentia in loco conidiogeno; perpendicularia, aequalia et horizontalia ad cellulas conidiogenas disposita. Teleomorphosis ignota.

Holotypus: INIFAT C94/60, in foliis dejectis *Paspali notati*, Santiago de las Vegas, INIFAT campus, Ciudad de la Habana, Cuba, leg. R. F. Castañeda, 3 Jun. 1994. Isotypus: MUCL 39020.

Conidial fungi, Hyphomycetes. Conidiomata sporodochial, superficial, hypophyllous, scattered, punctiform, black. Mycelium mostly immersed. Hyphae septate, branched, subhyaline to hyaline, smooth-walled, 2 - 2.5 µm diam. Stromata superficial, first colorless becoming brown, "textura angularis". Conidiophores differentiated, numerous, mononematous, clavate, hyaline, smooth, 25 - 32 x 7 - 10 µm, 3 - 4 µm wide at the base, sometimes compact, reduced to conidiogenous cells. Conidiogenous cells monoblastic, terminal, determinate, integrated, colorless, smooth. Conidia broadly ellipsoidal, globose, hemispherical to cerebriform, muriform, with black central cells, brown subcentral cells and subhyaline to hyaline margin; solitary, acrogenous, equilateral, dry, 10 - 16 x 9 - 12 µm, remaining transversely attached to the conidiogenous cell at maturity.

Holotype: INIFAT C94/60, on dead leaves of *Paspalum notatum*, Santiago de las Vegas, INIFAT camp, Havana city, Cuba, col. R. F. Castañeda, 3 Jul. 1994. Isotype: MUCL 39020. Cultures ex type: INIFAT C94/60, MUCL 39020 and CBS 415.95.

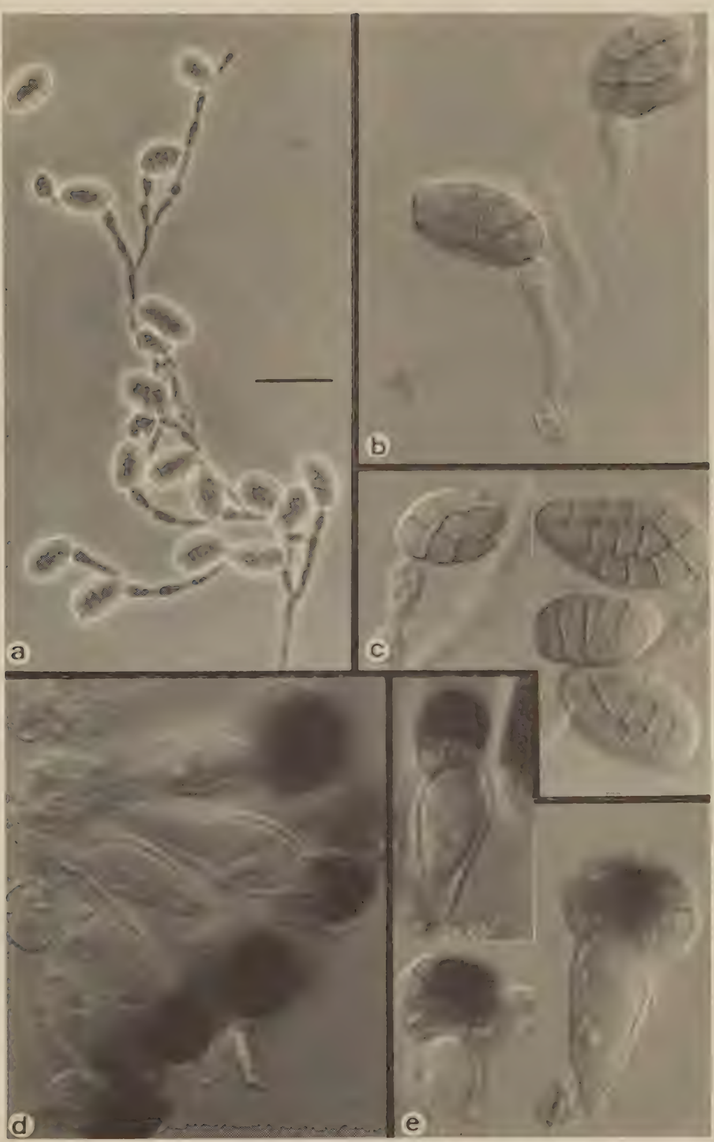

Fig. 2 - a,b,c *Cheiromoniliophora gracilis* (INIFAT C94/44). Conidiophores, conidiogenous cells and conidia. d,e *Oncopodium paspali* (INIFAT C94/60). Conidiophores, conidiogenous cells and conidia (a, bar = 25 µm; b-e, bar = 10 µm).

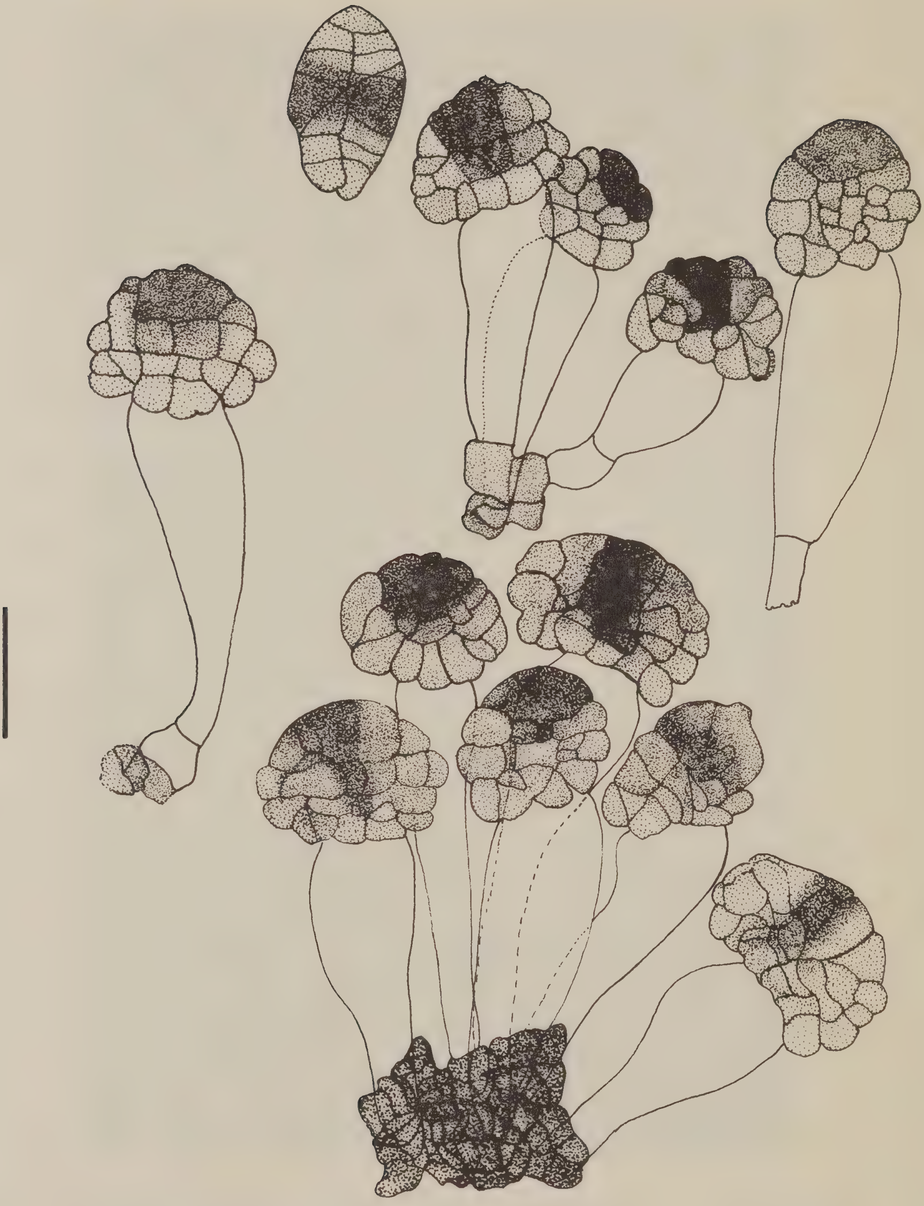

Fig. 3.- *Oncopodium paspali* (INIFAT C94/60). Stromata, conidiophores, conidiogenous cells and conidia. (bar = 10 µm).

Oncopodium was erected by Saccardo in 1904 (Ellis, 1971) with *O. antoniae* Sacc. & D. Sacc as type species. Six other species have been published later: *O. panici* Hudson 1961 (Ellis, 1971); *O. pruni* M. B. Ellis (1976); *O.simmonsii* Sutton (1978); *O. munjalii* N. D. Sharma (1980); *O. suttonii* Melnik (1988) and *O. aceris* Melnik (1988). Among previously described species only *O. panici* resembles *O. paspali* in the shape and pigmentation of the conidia, but *O. panici* has cylindrical conidiophores with a distinctive vesicle at the apex measuring 5 - 14 µm diam and conidia 21 - 32 x 11 - 16 µm, whereas *O. paspali* has clavate conidiophores and smaller conidia. *O. aceris* and *O. suttonii* have ellipsoid to ovoid conidia, 40 - 50 x 25 - 28 µm and 35 - 50 x 18 - 25 µm respectively. The difference between both species is not clear and both strongly resemble *Oncopodiella cubensis* G. Arnold & Castañeda Ruíz (1986), but no new combination is herein proposed because further studies are required.

KEY TO *ONCOPODIUM* SPECIES

1- Conidia with corniculate appendages 2
1'- Conidia without coniculate appendages 5

2- Conidia with 2 or more lateral appendages on either side 3
2'- Conidia never with more than 1 appendage on either side 4

3- Conidia hemispherical to oblong, 18-20 x 28-35 µm,
brown; with 2-3 horn-like hyaline appendages on
each side; stromata prosenchymatous .... *O. pruni*
3'- Conidia ellipsoidal to ovoid, 40-50 x 25-28 µm
dark-brown, with 1-2 nipple-shaped, hyaline appendages
on each side; stromata absent .... *O. aceris*

4- Conidiophores clavate, hyaline, with a swollen vesicle at the apex.
Conidia subglobose, brown,19-27 x 16-20 µm. .... *O. antoniae*
4'- Conidiophores cylindrical, brown to pale brown,without vesicle at
the apex. Conidia ellipsoid,dark-brown, 35-50 x 18-25 µm... *O. suttonii*

5- Conidiophores vesiculose at the apex. 6
5'- Conidiophores not vesiculose at the apex 7

6- Conidia hemispherical to subglobose, upper central part
domed-shaped, dark-brown at the center and pale brown
to subhyaline the rest, 21-32 x 11-16 µm .... *O. panici*

6'- Conidia oblong to hemispherical, pale brown to brown, 27-42 x 15-34 µm .... *O. munjalii*

7- Conidiophores clavate, hyaline. Conidia ellipsoidal, globose, hemispherical to cerebriform, with upper central cells black, and the rest hyaline; irregular margin;10-16 x 9-12 µm .... *O. paspali*

7'- Conidiophores cylindrical, pale brown. Conidia muriform, with one side dark brown and the other subhyaline to hyaline, 23-27,5 x 14,5-17 µm and 10,5-12,5 µm thick .... *O. simmonsii*

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ULTRASTRUCTURE AND CLASSIFICATION OF THE GENUS *SORODISCUS* (PLASMODIOPHOROMYCETES)

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ABSTRACT

Sorodiscus callitrichis and *S. cokeri* differ in morphology of resting spores (cysts), sporosori (cystosori), synaptonemal complexes, host-parasite boundaries, and nuclear volume. *Sorodiscus callitrichis* is considered to be a member of the group of plasmodiophorid genera characterized by *Sorosphaera*, whereas *Sorodiscus cokeri* is a member of the *Plasmodiophora* group. It is recommended to retain *Sorodiscus callitrichis* as a recognized taxon, but to rename *S. cokeri* as *Woronina cokeri*.

Additional Key Words: karyotype, plasmodiophorids, synaptonemal complex, *Woronina*

Winge (1912) described the genus *Sorodiscus* to include *S. callitrichis* Lagerh. et Winge, a gall-forming endoparasite in shoots of members of the aquatic genus *Callitriche* L. (Callitrichaceae). *Sorodiscus* was characterized by sporosori (cystosori or "spore-cakes") consisting of resting spores (cysts) arranged in two-layered disks without any space between the layers. Other recognized species within the genus *Sorodiscus* include *S. karlingii* Cook (1933), *S. radicicolus* Cook (1931, Ghemawat 1964), and *S. cokeri* Goldie-Smith (1951, 1956).

Sorodiscus callitrichis, *S. karlingii*, and *S. radicicolus* were described through sporogenic (cystogenous) stages of development; no sporangial (sporangiogenic) stages were reported. Goldie-Smith (1951) fully described at the light microscopic level both sporogenic and sporangial stages of *Sorodiscus cokeri*, an endoparasite on species of *Pythium*.

Wernham (1935) named the parasite of *Heteranthera dubia* (Jacq.) MacMillan as *S. heterantherae* Wernham. Braselton (1983), however, considered differences between the single-layered sporosoral disks of the plasmodiophorid on *H. dubia* and the two-layered spore-cake disks of *Sorodiscus* significant enough to retain the parasite on *H. dubia* as it was originally named, *Membranosorus heterantherae* Ostenfeld & Petersen (1930).

Palm & Burk (1933) considered the genus *Sorodiscus* as a synonym to the currently recognized genera *Sorosphaera* Schroeter, *Spongospora* Brunchorst, *Ligniera* Maire & Tison, and *Membranosorus*. Palm & Burk's reason for considering these genera as one was based primarily on variations of sporosoral morphology of *Sorosphaera veronicae* Schroeter from a single specimen of *Veronica americana* Schweinf. Winge (1912) recognized strong similarities between *Sorosphaera* and *Sorodiscus*, but kept the two genera separate, as did Cook (1933) and Karling (1968).

Braselton (cf. 1988, 1992) used transmission electron microscopy (TEM) to characterize stages of sporosoral development for most currently recognized genera of the plasmodiophorids, and recognized two groups of genera based on nuclear size, structure of synaptonemal complexes (SCs), and host-parasite boundaries. He considered all genera studied with TEM to be valid as based on sporosoral morphologies and haploid chromosomal numbers. The present study was initiated to determine how two species of *Sorodiscus*, *S. callitrichis* and *S. cokeri*, compare to other plasmodiophorids with regard to selected ultrastructural features during sporogenic development, and to determine if *Sorodiscus* should be considered a valid genus.

MATERIALS AND METHODS

Callitriche hermaphroditica L. with stem galls caused by *S. callitrichis* were collected from Rönneå, Skåne, Sweden, downstream from Klippan in August, 1988. *Sorodiscus cokeri* was isolated from soil samples obtained from Timrod Park, Florence, South Carolina, USA, and kept in culture on *Pythium pulchrum* V. Minden using methods detailed by Dylewski (1987) for *Woronina pythii* Goldie-Smith.

Specimens were fixed in 2-4% glutaraldehyde in 0.1 M phosphate buffer at pH 6.8 for 1-2 h at room temperature, rinsed with buffer, and post fixed with 1% OsO_4 in 0.1 M phosphate buffer at pH 6.8 for 45 min to 1 h at 4 C. Material was dehydrated in either a graded acetone or ethanol-propylene oxide series and embedded in an Araldite-Epon 812 mixture. We also used specimens of *Sorosphaera veronicae*, *M. heterantherae*, and *W. pythii* which we selected from material prepared for previous studies (Dylewski, Braselton, & Miller 1978, Braselton 1983, and Dylewski & Miller 1984) for comparisons of sporosori.

Sections for light microscopy were cut 0.5-1 μm thick and stained with 1% toluidine blue in 0.5% sodium tetraborate aqueous solution. Serial thin sections (gold, approx. 100-140 nm thick) for TEM were contrasted with aqueous uranyl acetate and lead citrate. Methods for measuring and counting SCs and for determining nuclear volume were described by Braselton (1987). Three nuclei, each from a different plasmodium, were analyzed for SCs and nuclear volume. Similarities and differences between both i) nuclear volume and ii) total length of SCs per nucleus for the different genera of Plasmodiophoromycetes were determined with the Kruskal-Wallis rank test for several independent samples (Conover 1980) at $p = 0.05$.

OBSERVATIONS

Transmission electron microscopy and optical microscopy revealed stages of sporogenic development consistent with those reported by previous investigators for other plasmodiophorids (Braselton 1988). Young plasmodia (Fig. 1, 5) contained nuclei with prominent nucleoli. Nuclear divisions in young plasmodia were cruciform (Fig. 2, 5). Nuclei of more mature, transitional plasmodia did not have nucleoli observable with light microscopy; ultrastructurally, nuclei in transitional plasmodia (Fig. 6, 9) contained SCs (Fig. 7, 8). Centrioles occurred in end-to-end pairs at the poles of nuclei in young (Fig. 2) and transitional plasmodia.

Host-parasite boundaries of young (Fig. 4) and mature plasmodia of *S. callitrichis* were a single, unit-membrane. For *S. cokeri*, however, host-parasite boundaries of young plasmodia were thicker than a unit membrane (Fig. 3), whereas boundaries of mature, transitional plasmodia were a single, unit membrane.

Uninucleate resting spores were formed following cleavage of transitional plasmodia. Sporosori of *S. callitrichis* were disk-like and consisted of two layers of urn-shaped resting spores (Fig. 13, 14); resting spores were 4 x 6 μm, and had walls up to 2 μm thick. There were no spaces between the cell walls of the resting spores in the two

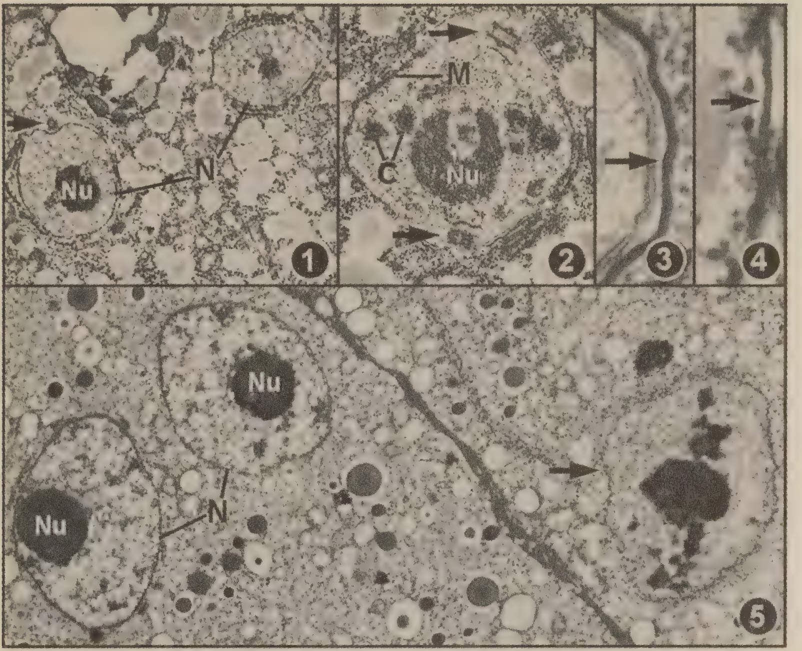

Fig. 1-5. Transmission electron micrographs of *Sorodiscus cokerii* and *S. callitrichis*. **Fig. 1.** Survey electron micrograph of *S. cokeri* young plasmodium showing profiles of two nuclei (N) in the field of view, with one nucleus sliced to show the prominent nucleolus (Nu) and a centriole (arrow). x5,800 **Fig. 2.** Cruciform nuclear division of *S. cokeri* with centrioles at each pole (arrows), the upper one showing the end-to-end orientation characteristic of plasmodiophorids. Chromatin (C) is at right angle to the persistent nucleolus (Nu), and there is a persistent membrane (M). x10,300 **Fig. 3.** Thick type of host parasite boundary (arrow) of young plasmodium of *S. cokeri*. x66,000 **Fig. 4.** Single membrane-type of host parasite boundary (arrow) of young plasmodium of *S. callitrichis*. x66,000 **Fig. 5.** Survey electron micrograph of *S. callitrichis* showing young plasmodium with interphase nuclei (N) with prominent nucleoli (Nu) in the host cell on the left, and in the host cell on the right a plasmodium with an oblique section through a nucleus in cruciform division (arrow). This figure is the same magnification as Fig. 1 for comparison of sizes of interphase nuclei of *S. cokeri* and *S. callitrichis*. x5,800

layers of *S. callitrichis*. Sporosori of *S. cokeri* varied in shape because some consisted of three (Fig. 10) and occasionally four sheets of resting spores in addition to the more commonly observed two layers (Fig. 10). Resting spores of *S. cokeri* were polyhedral, 3-4 μm across in their maximum dimension, and had cell walls approximately 0.1-0.3 μm thick (Fig. 10). Sporosori of *S. cokeri* had spaces between the cell walls of the two, three, or more layers (Fig. 10).

Since transitional nuclei of the two species differed significantly, each will be described separately in the following paragraphs. For *S. callitrichis,* SCs consisted of lateral elements separated by a central region 100-120 nm across (Fig. 8). Central elements were equidistant from both lateral elements and ends of SCs attached to the nuclear envelope. Thirty-six (36) SCs were counted in each of three analyzed pachytene nuclei of *S. callitrichis*; the haploid number was considered, therefore, to be 36. Lengths of pachytene SCs ranged from 1.36 ± 0.16 μm to 6.10 ± 0.60 μm, with a total length of SCs per nucleus 125.9 ± 9.38 μm. Nuclear volume of the three analyzed nuclei of *S. callitrichis* was 103.5 ± 11.2 μm^3.

Synaptonemal complexes of *S. cokeri* were poorly defined. Central regions were 80-90 nm across with central elements present only occasionally (Fig. 7). Ends of some SCs were attached to the nuclear envelope, but most profiles of SCs ended in the nucleoplasm. Since there were no reliable markers to indicate the actual ends of SCs in the nucleoplasm, determination of number and lengths of SCs was not completed for *S. cokeri*. Nuclear volume of three pachytene nuclei of *S. cokeri* was 8.26 ± 0.13 μm^3.

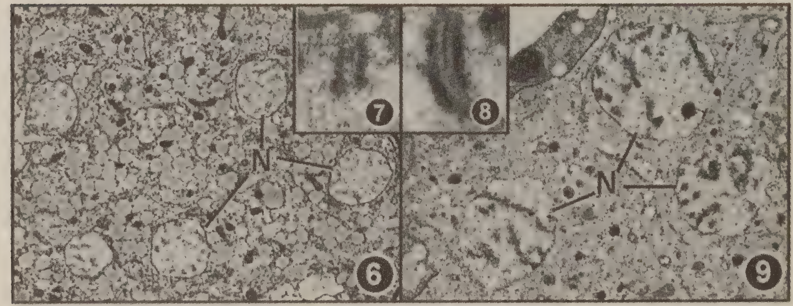

Fig. 6-9. Transmission electron micrographs of transitional plasmodia of *Sorodiscus cokerii* and *S. callitrichis*. **Fig. 6.** Survey micrograph of *S. cokeri* showing nuclear profiles that when viewed at higher magnifications are seen to contain synaptonemal complexes (Fig. 7). x3,600 **Fig. 7.** Profile of synaptonemal complex of *S. cokeri* at same magnification as Fig. 8. Lateral elements and central element are not as defined as those in SCs of *S. callitrichis* (Fig. 8). x18,600 **Fig. 8.** Profile of synaptonemal complex of *S. callitrichis* at same magnification as Fig. 7. Lateral elements and central element are more defined than are those in SCs of *S. cokeri* (Fig. 7). x18,600 **Fig. 9.** Survey micrograph of *S. callitrichis* showing nuclear profiles (N) that when viewed at higher magnifications are seen to contain synaptonemal complexes (Fig. 8). x3,600

DISCUSSION

The two species of *Sorodiscus* examined in this study differ significantly in sporosoral morphology, the traditional feature used to identify plasmodiophorid taxa (Karling 1968). The two-layered disks of *S. callitrichis* resemble the hollow, spherical sporosori of *Sorosphaera veronicae* (cf. Fig. 12, 13, & 14): The resting spores of *Sorosphaera veronicae* and *Sorodiscus callitrichis* appear similar with an overall urn-shape and thick cell walls. Resting spores of *S. cokeri* are smaller, polyhedral in overall shape, have thinner cell walls, and resemble resting spores of *Woronina pythii* (cf. Fig. 10 & 11). Layers of resting spores in *S. cokeri* sporosori are not tightly appressed as they are in *S. callitrichis*. Also, sporosori of *S. callitrichis* do not have more than two layers of resting spores, whereas sporosori of *S. cokeri* vary by having two, three, and four layers of resting spores.

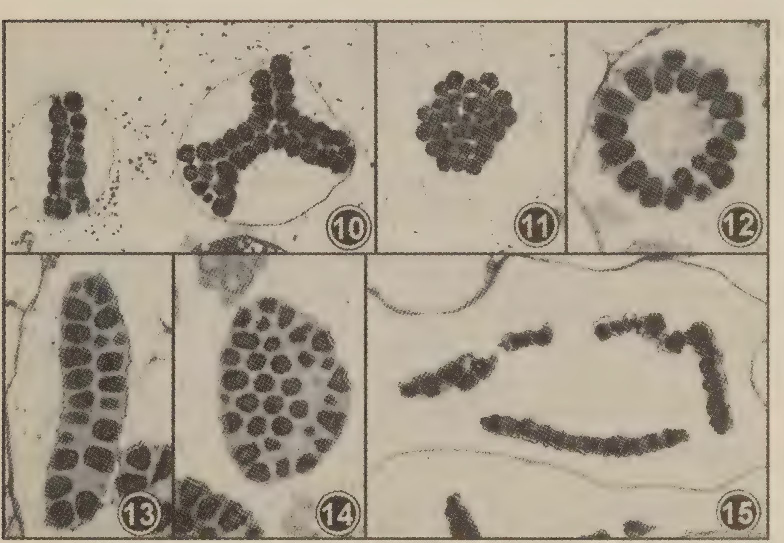

Fig. 10-15. Light micrographs of *Sorodiscus cokerii*, *Woronina pythii*, *Sorosphaera veronicae*, *Sorodiscus callitrichis*, and *Membranosorus heterantherae*. **Fig. 10.** Light micrograph of sections through two sporosori of *S. cokeri*. The one on the left has two layers of resting spores, whereas the one on the right has three layers. Note that there are gaps between the resting spores in the different layers. x700 **Fig. 11.** Light micrograph of section through sporosorus of *Woronina pythii*. x700 **Fig. 12.** Light micrograph of section through spherical sporosorus of *Sorosphaera veronicae*. x700 **Fig. 13.** Light micrograph of longitudinal section through sporosorus of *Sorodiscus callitrichis* showing two layers of resting spores. Note that there are no gaps between the resting spores in the two layers, but that the thick cell walls are tightly appressed to each other. x700 **Fig. 14.** Light micrograph of section through face view of sporosorus of *Sorodiscus callitrichis*. x700 **Fig. 15.** Light micrograph of section through sporosori of *Membranosorus heterantherae* showing predominantly single layers of resting spores. x700

The two species of *Sorodiscus* also differ in ultrastructural features. *Sorodiscus callitrichis* is very similar to *Sorosphaera veronicae* in overall appearance of plasmodial ultrastructure; host-parasite boundary of a single, unit membrane throughout development; SCs with clearly defined lateral and central elements; and SCs with a central region 100-120 nm across. Although total length of SCs per pachytene nucleus of *S. callitrichis* (125.9 ± 9.38 μm) is the largest reported for any plasmodiophorid taxon, it is not significantly different from the range of total SC lengths (approx. 51-81 μm) of *Sorosphaera veronicae*, *Spongospora subterranea*, *Ligniera verrucosa*, and the two species of *Polymyxa*, all members of the *Sorosphaera* group (Braselton 1992).

Nuclear volume of *S. callitrichis* (103.5 ± 11.2 μm^3) is the largest for plasmodiophorid taxa examined to date, and differs significantly from nuclear volumes of all other plasmodiophorids, including members of the *Sorosphaera* group (approx. 23-32 μm^3) (Table 1). Nuclear volume of *S. cokeri* (8.26 ± 0.13 μm^3), however, is not significantly different from nuclear volumes (approx. 14-15 μm^3) of *Woronina pythii* (Table 1) and *Plasmodiophora brassicae*, members of the *Plasmodiophora* group.

We recommend that *Sorodiscus callitrichis* be retained as a recognized taxon: It belongs to the *Sorosphaera* group (Braselton 1988) with regard to host-parasite boundary, SC structure, and SC total length. Although *S. callitrichis* resembles *Sorosphaera veronicae* in resting spore structure, it is distinct from *S. veronicae* in shape of sporosori (cf. Fig. 12-14), chromosomal number, and volume of pachytene nuclei (Table 1). Similarly, *S. callitrichis* differs from *Membranosorus heterantherae* in structure of resting spores and sporosori (cf. Fig. 13-15). These features along with differences in number and

Table 1. Comparison of ultrastructural karyological features of several plasmodiophorids. Data for *W. pythii* from Braselton & Dylewski (1986), *M. heterantherae* (Braselton 1989), and *Sorosphaera veronicae* (Harris *et al.* 1980).

Organism	**SC #**	**SC Min/Max Length (μm) mean (SD)**	**Total SC Length (μm) mean (SD)**	**Nuclear Volume (μm^3) mean (SD)**
Sorodiscus cokeri	ND	ND	ND	8.26(0.13)[a]
Woronina pythii	28	3.68(0.22)/ 0.96(0.12)	50.83(2.99)[d]	14.1(3.8)[a]
Sorodiscus callitrichis	36	6.10(0.60)/ 1.36(0.16)	125.90(9.38)[c]	103.5(11.2)
Sorosphaera veronicae	33	4.13(0.69)/ 1.09(0.31)	76.33(4.90)[c]	25.0(1.9)[b]
Membranosorus heterantherae	35	2.22(0.12)/ 0.84(0.13)	50.56(5.04)[d]	25.8(9.9)[b]

ND Not determined
[a b c d] Indicate means that do not differ significantly.

lengths of SCs, and nuclear volumes of the two taxa (Table 1) clearly distinguish *S. callitrichis* from *M. heteranthera*e.

There is sufficient reason to remove *Sorodiscus cokeri* from the genus *Sorodiscus* and place it in the genus *Woronina*. The organism, as does *Woronina*, belongs to the *Plasmodiophora* group (Braselton 1988) based on nuclear volume (Table 1), SCs with poorly defined lateral and central elements, SCs with central regions approximately 90 nm across or less, and relatively thick host-parasite boundaries in early stages of sporogenic development. *Sorodiscus cokeri* is indistinguishable from *Woronina pythii* in overall appearance of plasmodial ultrastructure and structure of resting spores. The two taxa are distinguishable, however, in morphology of sporosori (cf. Fig. 10 & 11). This latter point of distinction is important for identifying the two taxa since they both infect species of *Pythium* (Dylewski & Miller 1983, Goldie-Smith 1951). Because of similarities between *S. cokeri* and *Woronina pythii* and the differences between *S. cokeri* and *S. callitrichis*, we recommend that *Sorodiscus cokeri* be renamed *Woronina cokeri*.

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EPULORHIZA INQUILINA SP. NOV. FROM *PLATANTHERA* (ORCHIDACEAE) AND A KEY TO *EPULORHIZA* SPECIES

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Abstract

Epulorhiza inquilina sp. nov. is described from the mycorrhizas of mature plants of *Platanthera clavellata, P. cristata* and *P. integrilabia*, coexisting terrestrial orchids native to bogs in the southern Appalachians. The new taxon was isolated consistently and exclusively from these orchid taxa over a seven-year period. Protocorms from seeds of *P. integrilabia* planted in their native habitat were also colonized by *E. inquilina* and consequently some specificity in the symbiosis is suspected. *E. inquilina* is binucleate and has imperforate parenthesomes but differs from other species in the genus because of its woolly colonial morphology, tan colour on artificial media, and its elongate monilioid cells that develop in relatively short chains. The five species of *Epulorhiza* are distinguished in a key.

Introduction

Epulorhiza Moore (1987) is one of the most common and distinctive form-genera of Basidiomycotina that form mycorrhizas with terrestrial orchids (Currah and Zelmer, 1992). It appears to be less common, if it occurs at all, in the mycorrhizas of tropical epiphytic representatives of the Orchidaceae (Richardson and Currah 1995, Richardson et al., 1993). Recently, one of us (LWZ) recovered a number of strains of an undescribed species of *Epulorhiza* from the mycorrhizas of three species of *Platanthera* (*P. clavellata* (Michaux) Luer, *P. cristata* (Michaux) Lindley and *P. integrilabia* (Correll)

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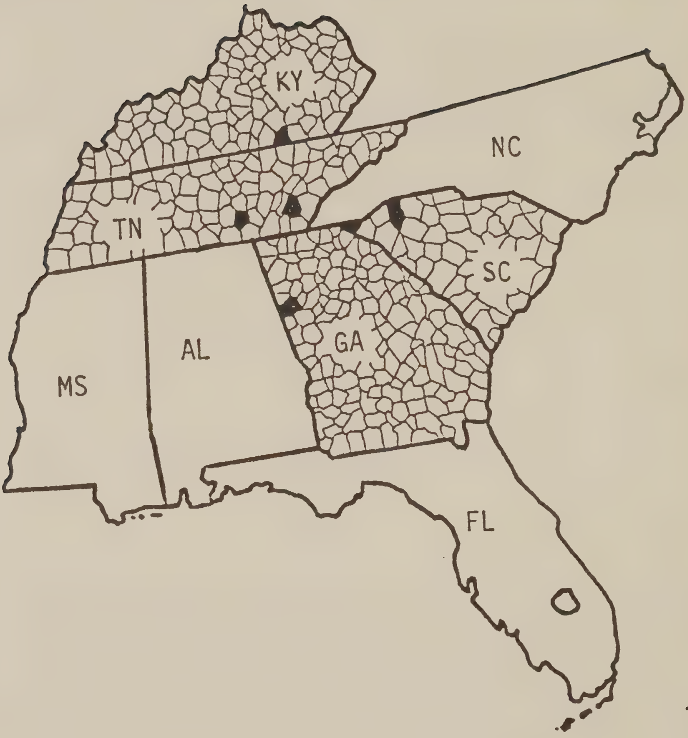
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Fig. 1. Collecting sites among four states in the southern Appalachians where orchid mycorrhizas containing *Epulorhiza inquilina* were collected.

Luer) native to shaded bogs of the southeastern United States (Fig. 1). The fungus was not isolated from thirteen other orchid species in the same region. Thus, some degree of specificity between the new fungal species and the three species of *Platanthera* that share similar habitats is suspected. The new species is effective at stimulating germination of the seeds of *P. integrilabia*, both *in situ* and *in vitro* and may have potential for conservation and horticulture (Zettler and McInnis 1992). In this paper we provide a name and diagnosis for the new species, provide some notes concerning its occurrence in the southeastern United States, and provide a key to the five species of *Epulorhiza* known from terrestrial orchids.

Materials and Methods

Healthy roots of mature plants of *P. clavellata, P. cristata* and *P. integrilabia* were obtained between 1989 and 1995 from orchids growing in Georgia, Kentucky, South Carolina and Tennessee. Vouchers representing the orchid taxa were deposited in Clemson University Herbarium (CLEMS). Mycorrhizal endophytic fungi were isolated following the methods of Currah et al. (1987) except root segments were surface sterilized 1 min in an aqueous solution (deionized water) containing 5% ethanol and 5% sodium hypochlorite and rinsed twice in dionized water. The epidermal layer was removed and clumps of cortical cells containing pelotons were macerated and plated on MMN (Marx 1969). Isolation plates were incubated in the dark at 22 C. Pure cultures and growth rates were obtained using the methods in Currah et al. (1987). Colony colours were determined using the Methuen colour codes (Kornerup and Wanscher 1983) after 40 days incubation in the dark at 22 C on Potato Dextrose Agar (PDA, Difco).

Isolation of mycorrhizal fungi from protocorms germinated in the natural habitat was carried out following the methods of Rasmussen and Whigham (1993). Seeds from mature green capsules of *Platanthera integrilabia* were collected October 1992 in McMinn Co., TN, and stored six months as outlined in Zettler and McInnis (1994). Between 50 and 500 seeds were placed in nylon packets (sifting material, 95 μm pore size, Carolina Biological Supply Co., #65-2222M) bound in plastic 35 mm (Polaroid) slide mounting frames. Each packet was stapled on all four sides, attached to a nylon fishing line, and buried in soil at a depth of ca. 5 cm, within 10-20 cm of the root systems of a mature stand of *P. integrilabia, P. clavellata* and *P. cristata* in late February. After 8 months the packets were retrieved, sealed in plastic bags, and stored in the dark at 6-8 C. Protocorms were removed from packets, surface sterilized 1 min in a solution containing 5 ml ethanol, 5 ml sodium hypochlorite and 90 ml of sterile deionized water and rinsed twice with sterile deionized water. Protocorms were plated on MMN agar and incubated in the dark at 22 C for two weeks. Pure cultures were obtained by subculturing hyphal tips. Living cultures of the type and other representative strains are deposited at the University of Alberta Microfungus Collection and Herbarium (UAMH), Edmonton, Canada.

Tests for the presence of cellulase and polyphenol oxidase follow the methods of Smith (1977) and Davidson et al. (1938), respectively. Reactions for the polyphenol oxidase assays were recorded as outlined in Zelmer and Currah (1995). Nuclear numbers of young hyphal cells were determined using DAPI fluorescent stain (Sneh et al. 1991). Septal ultrastructure was examined following the protocol given in Currah and Sherburne (1992). Morphology of monilioid cells in culture was noted on colonies grown on corn meal agar (CMA, Difco).

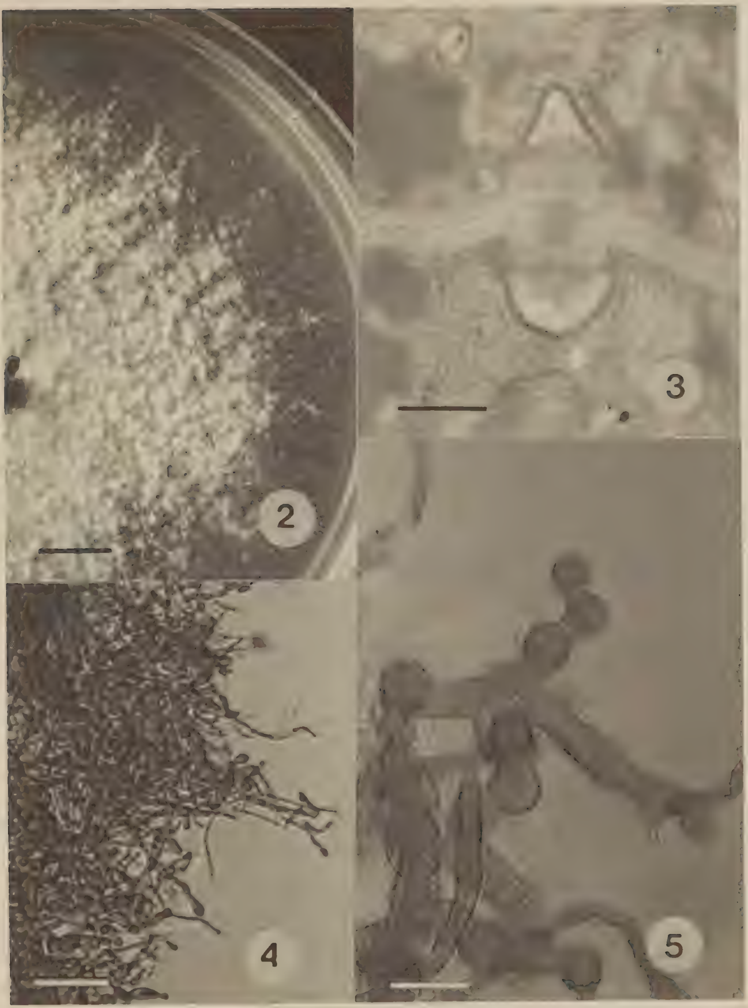
Taxonomic Part

Epulorhiza inquilina sp. nov.

In agaro dextroso solani tuberosi primum glabra, deinde alba vel griseo-brunnea, cristata per auctum mycelii aerii et glomerum cellularum monilioidarum, margo intacta. Cellulae binucleatae, regulariter septatae, parenthesomata imperforata, hyphae currentes 5-6 μm diam, hyalinae et plerumque tenuiter tunicatae. Elongatae ad ellipsoideae vel globosae, 11.1-25.8 x 9.1 - 12.7 μm, catenas simplices cellularum decem vel pauciorum formantes. Cellulae monilioidae glomera magna, deinde cristas vel sclerotia laxa formantes. Holotypus: colonia exsiccata ex UAMH 7632 de Platanthera integrilabia collecta in Pinnacle Mountain, Greenville Co., South Carolina, 1989.

Cultural morphology: On PDA, glabrous at first becoming white to greyish tan (4B2-5B2) and tufted as aerial mycelium (Fig. 2) and clusters of monilioid cells develop, margin entire.
Hyphae: Cells binucleate, regularly septate with imperforate parenthesomes (Fig. 3); runner hyphae 5-6 μm in diameter, hyaline and mostly thin-walled.
Monilioid cells: Elongate to elliptical or spherical, 11.1-25.8 x 9.1-12.7 μm in simple chains of 10 or fewer cells. Monilioid cells developing in loose sclerotial clusters that form tufts (Figs. 4 and 5).
Growth rate: 0.03 - 0.10 mm/hr.
Enzyme assays: polyphenol oxidase negative, weakly cellulolytic but not able to deteriorate cellophane membrane after 55 days.
Holotype: dried colony of UAMH 7632 from *P. integrilabia* collected at Pinnacle Mountain, Greenville Co., South Carolina, 1989, deposited at UAMH.
Additional Isolates: 115 (=UAMH 7811) from *P. clavellata*, Turkey Creek, Carroll Co., Georgia, 1989. 134 and 135 from *P. clavellata*, Tallulah Gorge, Rabun, Co., Georgia, 1989. 89 (=UAMH 7807) and 93 (=UAMH 7808) from *P. integrilabia*, Savage Gulf, Grundy Co., Tennessee, 1989. 136, 155 from *P. integrilabia*, Starr Mountain, McMinn Co., Tennessee, 1989. 235 (=UAMH 7809), 236, 237, 238, 239 from protocorms of *P. integrilabia* germinated *in situ*, Starr Mountain, McMinn Co., Tennesse, 1993. 163 (=UAMH 7810) from *P. cristata*, Starr Mountain, McMinn Co., Tennessee, 1989. 246 from *P. clavellata* growing in type locality of *P. integrilabia*, McCreary Co., Kentucky, 1995.
Etymology: "*inquilina*" refers to an inhabitant or lodger of foreign origin.

Species in the genus *Epulorhiza* usually have narrow vegetative hyphae, (2.5-3.5 μm broad) and produce relatively little aerial mycelium. *E. inquilina* differs from most species in *Epulorhiza* and bears a superficial resemblance to species in the genus *Ceratorhiza*. In most species of *Ceratorhiza* the vegetative hyphae are relatively broad (4-7 μm), and colonies are tufted and have relatively large amounts of aerial mycelia. However, placement of the new species in *Epulorhiza* is supported by the imperforate parenthesomes and the inability of the species to give a positive reaction for polyphenol oxidases on tannic acid media (Zelmer 1994). The species differs from others described in the genus as shown in the key (below).



Figs. 2-5. Characteristics of *Epulorhiza inquilina*. Fig. 2. Colony, 84 days on PDA, of *Epulorhiza inquilina* (ex type strain, UAMH 7632) from *Platanthera integrilabia*. Bar = 12.5 cm. Fig. 3. Section through septum of UAMH 7632 showing imperforate parenthesome. Bar = 1 µm. Fig. 4. Perimeter of a sclerotial aggregation of monilioid cells. Bar = 30 µm. Fig. 5. Short chain of ellipsoid to spherical monilioid cells after 33 days on PDA. Bar = 16 µm.

Peloton morphology in protocorms grown symbiotically lacks distinctive features. Hyphae tend to be narrow and uniform in diameter and form the typical interwoven masses of fungal cells characteristic of the symbiosis (Zettler and McInnis 1992). Monilioid cells have not been observed in the colonized cells of the host orchids.

The presence of this new species of *Epulorhiza* in a rare terrestrial orchid is noteworthy. *P. integrilabia*, currently listed as a C2 candidate for U.S. protection as an endangered species, is indigenous to the wet, shaded boggy areas of the Cumberland Plateau where it often grows in close association with *P. clavellata* and *P. cristata* (Zettler and Fairey 1990). *E. inquilina* was consistently and almost exclusively isolated from *P. clavellata, P. cristata* and *P. integrilabia* growing in shaded bogs in four states (Fig. 1). In all cases, the fungus was located in dull yellow-orange roots and was absent in the tuber. Twelve additional orchid taxa from the southern Appalachians, including two other species of *Platanthera*, which were examined for their mycorrhizal endophytes, did not yield *E. inquilina* . Thus, there may be some specificity between these three orchid species and their mycorrhizal partner. The isolation of *E. inquilina* from *P. integrilabia* seedlings germinated *in situ* suggests that this endangered orchid may rely on this single fungus species to complete its life cycle. If true, this might explain *P. integrilabia*'s limited geographical distribution. *In vitro* seed germination tests have also shown *E. inquilina* to be an effective symbiont with *P. integrilabia* (Zettler and McInnis 1992; 1994) but not with unrelated taxa, e.g., *Spiranthes cernua* (Linnaeus) L. C. Richard and *Goodyera pubescens* (Willdenow) R. Brown (Zettler and McInnis 1993), *Corallorhiza odontorhiza* (Willdenow) Nuttall, *Isotria medeoloides* (Pursh) Rafinesque and *Tipularia discolor* (Pursh) Nuttall (Zettler and McInnis, unpublished).

There have been five species included in *Epulorhiza.* Their principal distinguishing features in culture are emphasized in the following key.

KEY TO THE SPECIES OF *EPULORHIZA*

1. On PDA, runner hyphae usually 5 µm or broader in diam; colonies white to pale cream, grey or tan in colour; aerial mycelium abundant..................2
1. On PDA, runner hyphae usually narrow, < 5 µm in diam; colonies white, pale cream or pale orange in colour, aerial mycelium usually scant................3

2. On CMA, monilioid cells mostly globose and varying in size in a single chain, 15-24 x 10-12 µm......................................*E. albertaensis* Currah and Zelmer
2. On CMA, monilioid cells mostly elongate to elliptical, mostly of the same size, 11-26 x 9-13 µm, forming in short, branched chains.................*E. inquilina*

3. On PDA, colonies pale orange, monilioid cells clavate to irregular, 12-21 x 8-9 µm..*E. calendulina* Zelmer and Currah
3. On PDA, colonies white, pale cream, tan or grey, monilioid cells in long or short chains and variously shaped..4

4. On CMA, monilioid cells ellipsoidal, 14-18 x 7-10 µm, in long chains, adjacent cells in a chain connected by a narrow tube-like constriction..*E. anaticula* (Currah) Currah
4. On CMA, monilioid cells more or less globose, 13-18 x 8-17 µm, in chains, the junction between adjacent cells in a chain narrow or broad but not tube-like..*E. repens* (Bernard) Moore

Acknowledgments

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CERINOMYCES CURVISPORUS SP. NOV. (DACRYMYCETALES) FROM YUNNAN, CHINA*

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Abstract

Cerinomyces curvisporus sp. nov. belonging to the order Dacrymycetales is described and illustrated. This fungus differs from previously described species of *Cerinomyces* macroscopically by its odontoid hymenial surface and microscopically by having hyphal pegs and strongly curved, reniform basidiospores. A revised key to the known species of *Cerinomyces* is provided.

Key words: *Cerinomyces curvisporus*, Dacrymycetales, taxonomy, China.

Introduction

The genus *Cerinomyces* belongs to the order Dacrymycetales, and it is primarily characterized by nongelatinous corticioid basidiomata and dacrymycetaceous Y-shaped basidia. McNabb (1964) recognized the following six species as members of *Cerinomyces*: *C. altaicus* Parmasto (Parmasto, 1961), *C. canadensis* (Jacks. & Martin) Martin (Martin, 1949), *C. crustulinus* (Bourd. & Galzin) Martin (Martin, 1949), *C. grandinioides* McNabb (McNabb, 1964), *C. lagerheimii* (Pat.) McNabb (McNabb, 1964) and *C. pallidus* Martin (Martin, 1949). Subsequently, Ginns (1982) and Boidin and Gilles (1986) added *C. ceraceus* Ginns and *C. albosporus* Boidin & Gilles [= *C. aculeatus* Maekawa (Maekawa, 1987)] to this genus, respectively. In 1993, Maekawa collected a fungus belonging to *Cerinomyces* from the northwestern area of Yunnan Province in China. A comparison with the known species of the genus *Cerinomyces* showed this fungus to be distinct. Thus it is proposed as a new species.

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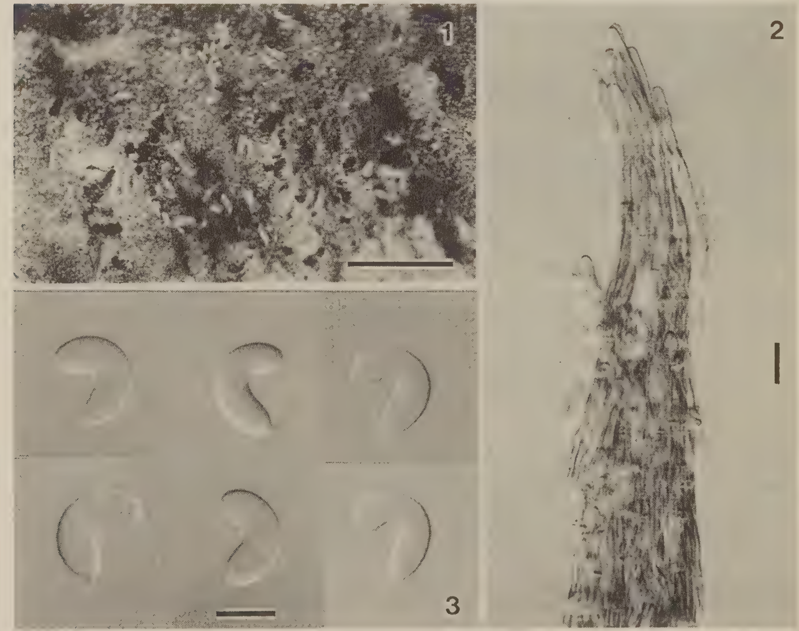
*Contribution no. 303 of the Tottori Mycological Institute.

Cerinomyces curvisporus Maekawa & Zang, sp. nov. (Figs. 1–6)

Basidiomata resupinata, adnata, effusa, 70–300 μm crassa; superficies hymenialis in statu sicco "Buff" (sec. Rayner, 1970), odontoidea (2–15 aculis per mm^2); margo et superficies hymenialis concolor, tenuiscens indeterminata, interdum sub lente (×20) fimbriata. In sectione subhyalina, pelliculosa vel membranacea. Systema hyphalis monomitica; hyphae 2–5 μm diametro, laeves, crassitunicatae, nodoso-septatae; clavi hyphales acuti, ex hyphis crassitunicatis (usque 2 μm), nodoso-septatis in fasciculis cohaerentibus usque 400 μm ex hymenio eminentibus compositi; probasidia cylindracea usque clavata,primo tenuitunicata tum pachypleurescentia (usque 0.5 μm), 38–50 × 6–9 μm, fibula basali praedita, 2 sterigmata 20–33 × 4.5–5.5 μm, producentia; basidiosporae curvireniformes, 15–18 × 5.5–6.5 μm, plerumque aseptatae quamquam rato 1 septis instructae, non-amyloideae.

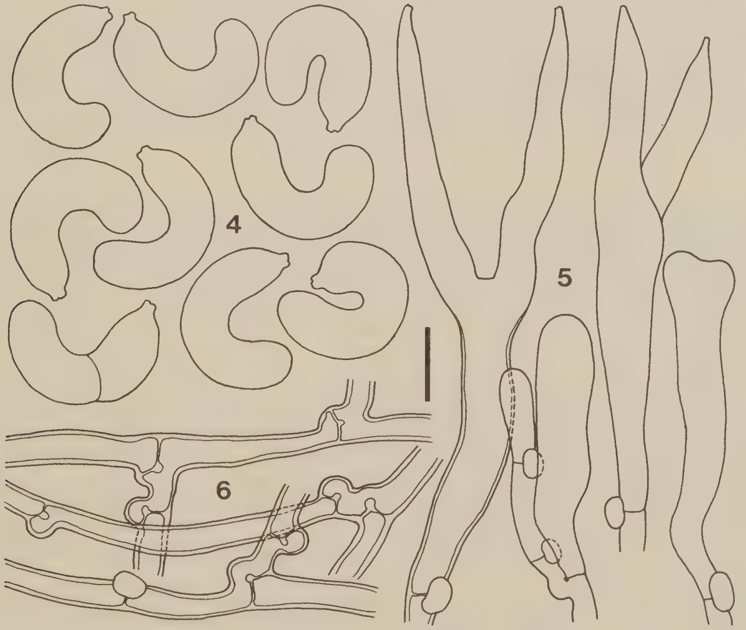
Specimen examined: Holotype in Cryptogamic Herbarium, Kunming Institute of Botany, Academia Sinica (HKAS); Isotypes in Tottori Mycological Institute (TMI-18048) and National Science Museum, Tokyo (TNS-F-175538), on decaying wood of *Pinus densata* Mast., Ganhaizi (3150 m alt.), at the foot of Mt. Yulong, Lijiang County, Yunnan Province, China, 16 Sept. 1993, N. Maekawa collect. no. 93091618.



Figs. 1–3. *Cerinomyces curvisporus*. 1. Hymenial surface. 2. Upper part of a hyphal peg. 3. Basidiospores. Scale bars = 1 mm in Fig. 1; 10 μm in Figs. 2 and 3.

Basidiomata resupinate, adnate, effused, 70–300 μm thick; hymenial surface "Buff" (based on Rayner, 1970) when dry, odontoid with sparse spines (2–15 per mm^2) due to projecting hyphal pegs; margin concolorous with the hymenial surface, thinning out, sometimes fimbriate under the lens (×20). In vertical section, subhyaline, pelliculose to membranous. Hyphal sytem monomitic; hyphae 2–5 μm in diam, smooth, thin- to thick-walled (up to 1.5 μm) nodose-septate; hyphal pegs acute, composed of thick-walled (up to 2 μm) and nodose-septate hyphae in coherent fascicles, sterile, projecting up to 400 μm beyond the hymenial surface; probasidia cylindrical to clavate, 38–50 × 6–9 μm, at first thin-walled, becoming slightly thick-walled (up to 0.5 μm),with a basal clamp, producing 2 sterigmata, 20–33 × 4.5–5.5 μm; basidiospores reniform, strongly curved, 15–18 × 5.5–6.5 μm, with distinct apiculus, aseptate or rarely with one septum, smooth, thin-walled, non-amyloid.

Cerinomyces curvisporus is characterized by its odontoid hymenial surface (Fig. 1), hyphal pegs (Fig. 2) and strongly curved, reniform basidiospores (Figs. 3 and 4). Among the previously known species of *Cerinomyces*, *C. albosporus* Boidin & Gilles (Boidin and Gilles, 1986) is most similar to *C. curvisporus* in forming odontoid hymenial surface and hyphal pegs. However, they differ in basidiospore morphology, i.e., *C. albosporus* forms cylindrical to allantoid basidiospores measuring 13–16 × 4.5–6 μm, whereas those of *C. curvisporus* are strongly curved, reniform and larger, 15–18 × 5.5–6.5 μm. The features distinguishing *C. curvisporus* from the known species can be found in the following key.



Figs. 4–6. *Cerinomyces curvisporus*. 4. Basidiospores. One (left at the bottom) showing a septum. 5. Basidia and basidioles. 6. Hyphae. Scale bar = 10 μm.

Key to species of the genus *Cerinomyces*

1. Hyphae with clamp at every septum ·········· 2
1. Hyphae without clamps (from Ginns, 1982) ·········· 7

2. Hymenial surface smooth ·········· 3
2. Hymenial surface odontoid; hyphal pegs present ·········· 6

3. Septate basidiospores lacking ·········· 4
3. Septate basidiospores present ·········· 5

4. Basidiospores less than 9 μm long ·········· ***C. pallidus***
4. Basidiospores larger than 9 μm long ·········· ***C. crustulinus***

5. Basidiospores sometimes with 1–3 septa, 13–17 × 4.5–5.5 μm ·········· ***C. altaicus***
5. Basidiospores rarely with a septum, 11–14.5 × 4–5 μm ·········· ***C. canadensis***

6. Basidiospores subcylindrical to suballantoid, 13–16 × 4.5–6 μm ·········· ***C. albosporus***
6. Basidiospores reniform, strongly curved, 15–18 × 5.5–6.5 μm ·········· ***C. curvisporus***

7. Hymenial surface smooth; hyphae mostly thick-walled (to 2 μm), gelatinizing in 2% KOH; basidiospores 0–1(–2, rarely 3) septate ·········· ***C. lagerheimii***
7. Hymenial surface minutely odontoid or with scattered spines; hyphae with thin to thick (to 1.2 μm) walls, not gelatinizing in 2% KOH; basidiospores typically 3 septate ·········· 8

8. Hymenial surface with scattered spines; hyphae, basidia and basidiospores with thickened walls; globose to fusoid hyphal swellings ·········· ***C. ceraceus***
8. Hymenial surface minutely odontoid; hyphae, basidia and basidiospores thin-walled (occasionally as much as 0.6 μm thick); swellings lacking ·········· ***C. grandinioides***

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NEW PARAPHAEOSPHAERIA SPECIES AND THEIR ANAMORPHS

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ABSTRACT

Two new species of *Paraphaeosphaeria, P. agavensis* and *P. nolinae*, are described and illustrated. Both species are morphologically similar to *P. obtusispora*, but have different anamorphs. The anamorph of *P. agavensis* was not seen on the host but its cultural form is noted. A new genus, *Phaeostagonospora*, is described for the anamorph of *Paraphaeosphaeria nolinae. Microsphaeropsis sp.* was found to be the anamorph for *Paraphaeosphaeria quadriseptata.*

Key Words: *Agave,* coelomycete, *Coniothyrium, Dasylirion,* Loculoascomycete, *Microsphaeropsis, Nolina, Paraphaeosphaeria*, *Phaeostagonospora*

INTRODUCTION

Paraphaeosphaeria O. Erikss. was established to accommodate segregates of *Leptosphaeria* Ces. & De Not. with asci and ascomata as in *Phaeosphaeria* Miyake, ascospores with an inflated cell immediately above the A1 septum and a longer, more highly septate proximal than distal hemispore, and a *Coniothyrium* Cda. anamorph (Eriksson 1967). *Paraphaeosphaeria obtusispora* (Speg.) O. Erikss., a species with 5-septate ascospores and 1-septate distal hemispores, has been reported from *Agave* L., *Yucca* L., *Fourcroya* Spreng., and *Aloe* Tourn. *ex* L. (Lucas 1963). In recent collections of *Agave, Dasylirion* Zucc., and *Nolina* Michx. from Big Bend National Park, specimens were assigned to *P. obtusispora* on the basis of ascospore characters. However, cultures of asci from these three hosts produced three different anamorphs. These cultural results necessitated a reconsideration of *P. obtusispora.*

MATERIALS AND METHODS

Cultures from anamorphs were obtained by suspending conidia in a drop of sterile tap water on potato dextrose agar (PDA, Difco) in a petri plate and spreading the drop with a sterile glass rod. After 24 hours, growth from single germinated conidia was transferred to PDA slants. Cultures of teleomorphs were obtained by washing individual asci three times in sterile tap water and placing them on petri plates of PDA. When sufficient growth was present, transfers were made to PDA slants. Cultures were maintained at room temperature. Measurements were made on hand sections or squashes in tap water from living materials unless indicated otherwise.

TAXONOMY

Paraphaeosphaeria agavensis A. W. Ramaley, M. E. Palm, *et* M. E. Barr, *sp. nov.*, Fig. 1, A-G.

Ascomata immersa, subepidermalia, erumpentia, globosa, uniloculata, atricolorata, crassiparieta, singularia vel aliquot stromati basali insidentia, omnia papilla brevi distincta, 250-500 x 250-500 μm. Parietes laterales 50-80 μm crassi, ex 8-10 stratis cellularum atricolorium, crassitunicatarum compositi. Ostiolum periphysibus et pseudoperiphysibus repletum. Asci bitunicati, cylindracei, brevistipitati, 128-180 x 17.6-21.6 μm, in hymenio lato. Pseudoparaphyses numerosae, cellulosae, ca 2.4 μm latae. Ascosporae cylindraceae, ex apice cellula quarta tumida, 28.8-36.8 x 8.8-11.2 μm, 5-septatae, septum primum submedium, fulvae, subtiliter punctatae, in asco biseriatae imbricatae.

In foliis mortuis *Agave havardiana* Trel. 'U.S.A. TEXAS: Brewster County, Big Bend National Park, point above road across from Lost Mine Trailhead parking lot, 9 May 1994,' a Annette Ramaley 9409A lecti (BPI holotypus, UC 1475192 isotypus). In foliis mortuis *Agave sp.* 'MEXICO: Intercepted Brownsville Texas #023088, 6 April 1992,' a N. Guerrero lecti, det. M. E. Palm, M. E. Barr (BPI 1111149 paratypus).

ANAMORPH. Conidiomata pycnidia. Cellulae conidiogenae determinatae, discretae vel integratae conidiophoris ramosis vel inramosis. Conidia bacillaria 4-6.4 x 1.6-2.4 μm, hyalina, gutullata, guttulis candidis vel roseis liberata.

Ascomata (Fig. 1, C) immersed, subepidermal, erumpent, globose, unilocular, very dark, thick-walled, single or in small groups on a basal stroma, each with a distinct, short, papilla, 250-500 x 250-500 μm. Side walls 50-80 μm thick, composed of 8-10 or more layers of very dark, thick-walled cells. Ostiole filled with periphyses and pseudoparaphyses. Asci (Fig. 1, A) bitunicate, cylindric, short stipitate, 128-180 x 17.6-21.6 μm, in a broad hymenium. Pseudoparaphyses numerous, cellular, ca 2.4 μm wide. Ascospores (Fig. 1, B) cylindric, fourth cell from apex enlarged, 28.8-36.8 x 8.8-11.2 μm, 5-septate, first septum submedian, yellow-brown, finely punctate, overlapping biseriate in the ascus.

In dead leaves of *Agave*.

ANAMORPH. Conidiomata pycnidial. Conidiogenous cells determinate, discrete or integrated on branched or unbranched conidiophores (Fig. 1, F).

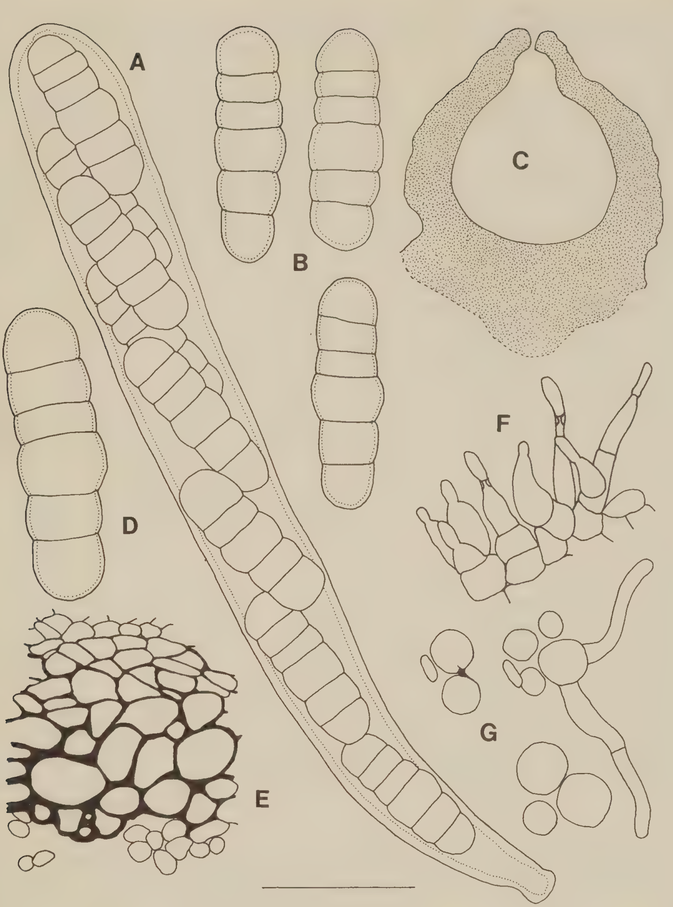

FIG. 1. (A-G) *Paraphaeosphaeria agavensis* (holotype). A. Ascus. B. Ascospores. C. Ascoma. D. Ascospore from culture. E. Wall of ascoma. F. Conidiophores and conidiogenous cells from culture. G. Conidia and small colony from culture. Most conidia have rounded up, and increased in size in preparation for colony formation. Standard Line: A=25μm; B, D, F, G=20 μm; C=250 μm; E=50 μm.

Conidia bacillar, 4-6.4 x 1.6-2.4 μm, hyaline, gutullate, released in white to pinkish droplets. Known only from culture.

Several characteristics separate *Paraphaeosphaeria agavensis* from *P. obtusispora*. (1) *P. agavensis* asci and ascospores are larger than those of *P. obtusispora* (FIG. 1, A, B; Fig. 3, A, D; Table I, 1-8). (2) Peridia of *P. obtusispora* are thin, 17-30 μm, and composed of a few layers of rather thin-walled *textura angularis* (Shoemaker & Babcock 1985); peridia of *P. agavensis* are thick, 50-80 μm or more, and composed of several layers of thick-walled *textura angularis* (FIG. 1, E; Fig. 3, B). (3) *P. obtusispora* ascomata appear singly and remain below the host epidermis; *P. agavensis* ascomata often appear in small groups adjacent to old *Piptarthron* Mont. *ex* Höhn. conidiomata. The grouped ascomata of *P. agavensis* (4) are seated on a basal stroma and (5) are erumpent--entire ascomata can be seen from above, encircled by, but not in close association with, upturned flaps of the host epidermis. (6) The anamorph for *Paraphaeosphaeria* is *Coniothyrium* and for *P. obtusispora* it is said to be *Coniothyrium henriquesii* Thüm. (Lucas 1963), a species with tardily 1-septate conidia which Petrak and Sydow transferred to *Microdiplodia* Allesch. Cultures of asci from *P. agavensis* form small, dark-walled, irregularly shaped conidiomatal chambers, mostly in stromatic areas developed at the agar surface. The hyaline conidiogenous cells lining these chambers form bacillar, hyaline conidia. These small conidia, which remain hyaline, were thought to be spermatia, but when spread on PDA, they may become globose (Fig. 1, G), increase in size, germinate, and form typical colonies. This conidial phase of *P. agavensis* differs significantly from *Coniothyrium*. Ascomata were found in a culture that had been producing conidia for several weeks, so the conidia might serve as spermatia if spermatia are, in fact, essential for formation of ascomata. Ascospores from these ascomata were more frequently misdivided than in nature, and were somewhat larger--31.2-44 x 9.6-16 μm--but the shape and septation of the usual ascospores were typical (Fig. 1, D).

It may be questioned whether the conidia from cultures are the only sort formed in the asexual phase of *P. agavensis*. The holotype has no conidial phase closely associated with the ascomata. The paratype specimen of *P. agavensis* includes conidiomata of a *Microsphaeropsis* Höhn., but conidial cultures produced colonies and aseptate conidia indistinguishable from those from cultures of *Paraphaeosphaeria quadriseptata* M. E. Barr which was also present and closely associated with the *Microsphaeropsis* condiomata. Cultures of the *P. agavensis* paratype formed colonies and conidia like those of the holotype.

Paraphaeosphaeria nolinae A. W. Ramaley, *sp. nov.*, Fig. 2, A-F.

Ascomata immersa, subepidermalia, globosa vel aliquantum elongata, saepe inter conidiomata vel prope maculas anamorphosum continentes, singularia vel aliquot aggregata secus fissuram stomatophoram hospitis, tum parietes plus minusve confluentes, 225-325 μm longa, 200-325 μm lata, et 200-375 μm alta, apex contra epidermidem hospitis depressus, papilla parva epidermidem hospitis penetrans.

Ostiolum periphysibus et pseudoparaphysibus repletum. Peridium plerumque 20-50 µm crassum lateribus et base, crassius apice, ex 3-7 stratis cellularum, plura strata apice compositum, strata exteriora aliquantum crassitunicata, strata interiora plerumque tenuiora, hyphae brunneae copiosae ex peridio in substratum. Asci bitunicati, cylincracei, versus basem decrescentes, brevistipitati, 136-168 x 13.6-16(-17.6) µm, numerosi. Pseudoparaphyses cellulosae, numerosae usque ad maturitatem ascomatum. Ascosporae cylindraceae, ex apice cellula quarta tumida, 22.4-34.4 x 8-9.6 µm, 5-septatae, septum primum submedium, fulvae, subtiliter punctatae, in asco biseriatae imbricatae. Anamorphosis: Phaeostagonospora nolinae A. W. Ramaley.

In foliis mortuis *Nolina erumpens* (Torr.) Wats. 'U.S.A. TEXAS: Brewster County, Big Bend National Park, 1.8 miles from U. S. Hwy. 385 on road to The Basin, 8 May 1994,' a Annette Ramaley 9407A lecti (BPI holotypus). In foliis mortuis *Nolina erumpens* (Torr.) Wats. 'U.S.A. TEXAS: Brewster Co., Big Bend National Park, 3.75 miles from U. S. Hwy. 385 on road to The Basin, ca 500' beyond stone-sided bridge and down slope, 9 May 1994,' a Annette Ramaley 9408B lecti, (UC 1475193 paratypus).

ANAMORPH: ***Phaeostagonospora nolinae*** A. W. Ramaley, *gen. et sp. nov.*, Fig. 2, E-F.

Conidiomata immersa, subepidermalia, singularia, secus fissuram stomatophoram hospitis, elongata vel globosa, apex contra epidermidem hospitis depressus 175-425 µm longa, 150-250 µm lata, 175-300 µm alta, papilla parva epidermidem hospitis penetrans. Paries 16-32 µm crassus, ex 3-6 stratis cellularum brunneotunicatarum et 1-2 stratis hyalinis interioribus compositus, hyphae copiosae dilutebrunneae ex parieto in substratum. Cellulae macroconidiogenae discretae, leves, hyalinae, tenuitunicatae, doliiformes, ampulliformes vel irregulariter formatae; ontogenesis conidiis holoblastica constructione ad parietem apicalem; proliferatio cellularum conidiogenarum holoblastica; condia addita ad puncta succesiva altiora formata. Macroconidia ellipsoidea vel cylindracea, extrema obuse rotundata, 15.2-20(-21.6) x (6.4-)7.2-9.6 µm, (1-)3-transerse septata, aliquando septo longitudinali, brunnea, foveolata. Microconidia globosa vel ellipsoidea, ca 5-6 µm, hyalina, levia, pariete supero conidiomatis prope ostiolum formata.

In foliis mortuis *Nolina erumpens* (Torr.) Wats., 'U.S.A. TEXAS: Brewster Co., Big Bend National Park, 1.8 miles from U. S. Hwy. 385 on road to The Basin, 8 May 1994,' a Annette Ramaley 9407B lecti (BPI holotypus).

Ascomata (FIG. 2, D) immersed, subepidermal, globose or somewhat elongate, often mixed with or adjacent to the anamorph, single or in small groups along the stomatal cleft of the host, the walls then more or less confluent, 225-325 µm long, 200-325 µm wide, and 200-375 µm tall, the apex flattened against the host epidermis, a small papilla penetrating the host epidermis. Ostiole filled with periphyses and pseudoparaphyses. Peridium mostly 20-50 µm thick at the sides and bottom, thicker toward the top, composed of 3-7 layers of cells (FIG. 2, C), more layers at the top, the outer

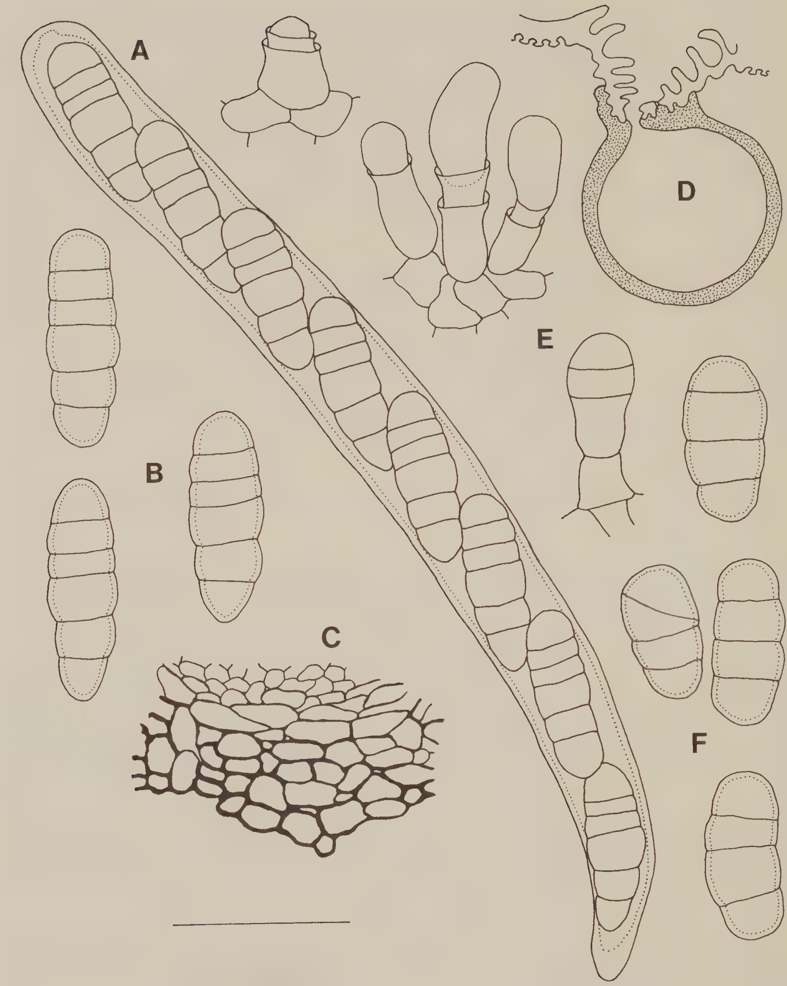

FIG. 2. (A-D) *Paraphaeosphaeria nolinae* (holotype). A. Ascus. B. Ascospores. C. Wall of ascoma. D. Ascoma. (E, F) *Phaeostagonospora nolinae* (holotype) E. Macroconidia and conidiogenous cells. F. Macroconidia. Standard line: A=25 μm; B, E, F=20 μm; C=50 μm; D=250 μm.

layers rather thick-walled, inner layers usually thinner, abundant brown hyphae from the peridium into the substrate. Asci (FIG. 2, A) bitunicate, cylindric, narrowing toward the base, short stipitate, 136-168 x 13.6-16(-17.6) μm, numerous. Pseudoparaphyses cellular, numerous even at maturity. Ascospores

(FIG. 2, B) cylindric, fourth cell from apex enlarged, 22.4-34.4 x 8-9.6 μm, 5-septate, first septum submedian, yellow-brown, finely punctate, overlapping biseriate in the ascus.

In dead leaves of *Nolina erumpens.*

Conidiomata immersed, subepidermal, single, lining the stomatal cleft of the host, elongate to globose, the top flattened against the host epidermis, 175-425 μm long, 150-250 μm wide, and 175-300 μm tall, a small papilla penetrating the host epidermis. Wall 16-32 μm thick, composed of 3-6 layers of brown-walled cells and 1-2 hyaline layers at the interior, abundant light brown hyphae from the wall into the substrate. Macroconidiogenous cells (FIG. 2, E) on the interior of the conidiomatal wall, discrete, smooth, hyaline, thin-walled, doliiform, ampulliform or irregular in shape, hyaline; conidial ontogeny holoblastic by apical wall building; proliferation of conidiogenous cells holoblastic; additional conidia produced at successively higher points. Macroconidia (FIG. 2, F) ellipsoid to cylindric, ends bluntly rounded, 15.2-20(-21.6) x (6.4-)7.2-9.6 μm, (1-)3-transversely septate with an occasional longitudinal septum, brown, foveolate. Microconidia globose or ellipsoid, ca 5-6 μm, hyaline, smooth, formed on the upper conidiomatal wall near the ostiole.

In dead leaves of *Nolina erumpens.*

Paraphaeosphaeria nolinae can be separated from *P. obtusispora* by the somewhat larger ascospores and asci, the thicker peridium (FIG. 2, A-C; Fig. 3, A, B, D; Table I, 1-7, 9), and the *Phaeostagonospora* anamorph. Ascospore length of *P. obtusispora* on *Aloe* (Lucas 1963), also measured on living material, is included within the measurements for *P. nolinae*, but width of the ascospores, and length and width of the asci are greater for *P. nolinae* than *P. obtusispora* on *Aloe* (Lucas 1963), *Smilax* (Tourn.) L. (M. E. Barr, personal communication) or *Yucca* (Hedjaroude 1968; Shoemaker & Babcock 1985; M. E. Barr, personal communication), where measurements were made on dead material. While the size differential might be insufficient to establish another *Paraphaeosphaeria* species with 5-septate ascospores, the different anamorph makes it necessary to do so.

In the older literature, the anamorph of *Paraphaeosphaeria nolinae* 'keys' to *Hendersonia* Berk. which is a *nomen rejiciendum* in favor of *Stagonospora* (Sacc.) Sacc. *Stagonospora* may have conidiogenous cells with percurrent proliferations (Sutton 1980), but the conidia are thin-walled, hyaline, and smooth, not thick-walled, brown, and sculptured as in *P. nolinae. Phaeostagonospora nolinae* conidia resemble those of *Parahendersonnia dasylirionis* A. W. Ramaley (1995) as to size, septation, color, and sculpturing, but conidiogenesis is annellidic, not phialidic. Other genera with brown, septate conidia and percurrently proliferating conidiogenous cells were considered for the *P. nolinae* anamorph. *Hendersonula* Speg. is pathogenic (Sutton and Dyko 1989); *Neohendersonia* Petrak is often multilocular, the wall consists of an outer layer of dark, thick-walled *textura porrecta* or *intricata* and an inner layer of hyaline, thin-walled *textura angularis*, and the versicolored conidia are euseptate or distoseptate (Sutton 1980); *Kirramyces* J. Walker, B. Sutton & I. Pascoe, a *Eucalyptus* L'Hérit. leaf parasite, has brown, verruculose conidiogenous cells, and the conidia are long and tapered to rounded apices (Walker et al 1992); and *Sonderhenia* H. Swart & J. Walker, also a *Eucalyptus* leaf parasite, has brown conidiogenous cells, conidia are distoseptate, and hyaline hyphae extend from the ostiole above leaf stomata (Swart and Walker 1988). Because no existing genus accommodated this fungus, *Phaeostagonospora* is established.

DISCUSSION

Multiple anamorphs for a single teleomorph are common in the ascomycetes, so a search was conducted to find teleomorph species whose anamorphs varied with the teleomorph host. Bitunicate ascomycetes with multiple anamorphs, documented by frequent cohabitation or experimental means, were located in the list of teleomorph-anamorph connections (Kendrick & DiCosmo 1979) in 'The Whole Fungus.' Thirteen of these connections could not be traced because the literature was unavailable to me. In 85 cases the multiple connections involved a (macro)conidial and a spermatial or microconidial state, cultural synanamorphs, various conidial forms on the same mycelium on the host, multiple anamorphs in single-spore cultures, conidial states that were later considered synonyms or probable synonyms, conidial states that belonged to separate teleomorphs, and states that later authors denied belonged together. Only *Guignardia cytisi* (Fuck.) Arx et Müller cultured from different hosts yielded different anamorphs (Müller 1957). Cultures from two hosts formed conidia of the *Dothiorella* Sacc. species found on the hosts, while cultures from a third host formed *Selenophoma* Maire conidia found on all three hosts. However, one *Dothiorella* species is now a synonym of *Macrophomopsis coronillae* (Desm.) Petrak (Sutton 1980) with no teleomorph cited, and the anamorph for *G. cytisi* is given as *Selenophoma juncea* (Mont.) Arx (Sivanesan 1984; Sutton 1980). If not unique among teleomorph-anamorph connections, *Paraphaeosphaeria obtusispora s. lat.* is at least unusual. This may be because it was common in the past, to name as new, fungi encountered on a new host without considering similar species on related hosts. The two newly described species of *Paraphaeosphaeria* are not separated because they occur on different hosts, but because they differ from *P. obtusispora*, and the anamorph corresponding to each host and teleomorph species is significantly different.

A small spot of a *Paraphaeosphaeria* species was found on one leaf of *Dasylirion leiophyllum* Engelm. collected a few hundred feet from the specimen of *P. agavensis* on *Agave havardiana*. The size of the few ascomata present resembled ascomata of *P. nolinae* (TABLE I, 9, 10). The ascospores (FIG. 3, F; Fig. 1, B; Fig. 2, B; Table I, 8-10) were different from those of *P. agavensis* as well as *P. nolinae*, but much like those of *P. obtusispora* (FIG. 3, D; Table I, 1-7, 10). Colonies from cultured asci formed *Microsphaeropsis* conidiomata at the agar surface. Conidia from cultures, as well as from a *Microsphaeropsis* accompanying the *Paraphaeosphaeria* ascomata on the host, were spheric to

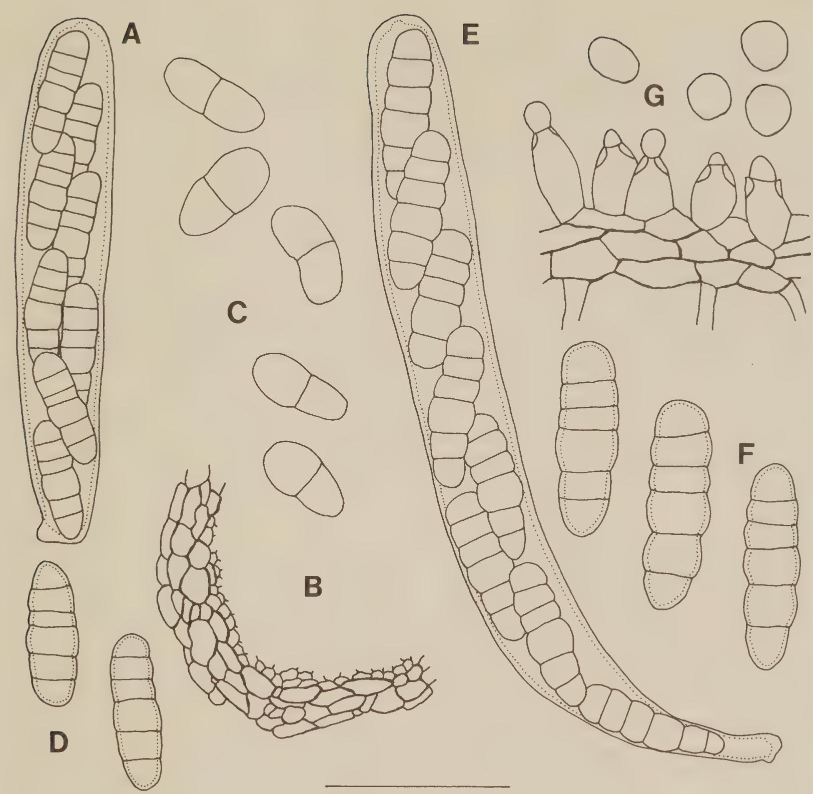

FIG. 3. (A, B, D) *Paraphaeosphaeria obtusispora* (BPI 622569). A. Ascus. B. Wall of ascoma. D. Ascospores. (C) Conidia of coelomycete accompanying *Paraphaeosphaeria obtusispora* (BPI 622569). (E, F) *Paraphaeosphaeria sp.* from *Dasylirion*. E. Ascus. F. Ascospores. (G) Conidiogenous cells and conidia of the *Microsphaeropsis sp.* accompanying *Paraphaeosphaeria sp.* on *Dasylirion*. Standard line: A, E=25 μm; C, D, F, G=20 μm; B=50 μm.

broadly ellipsoid and 4.0-5.6 μm diam (FIG. 3, G). Conidia of *Coniothyrium henriquesii*, the anamorph of *P. obtusispora* are oblong to ovoid, and 6-10 x 3-4 μm (Sivanesan 1984). These results suggest that the species of *Paraphaeosphaeria* on *Dasylirion* should also be separated from *P. obtusispora* when sufficient material can be located for a formal description.

Paraphaeosphaeria obtusispora BPI 622569 from *Yucca sp.* (Table I, 7) has ascospore and ascus dimensions within the range for *P. obtusispora* (Table I, 1-7). Intermixed with ascomata were conidiomata of so similar size, color, and relationship to the host that they could be reliably separated only by dissection.

TABLE I. Dimensions of *Paraphaeosphaeria obtusispora* (1-7), *P. agavensis* (8), *P. nolinae* (9) and *P. sp.* (10).

SUBSTRATE Author	ASCOSPORES (μm)	ASCI (μm)	ASCOMATA (μm)	WALL (μm thick)
1. *Yucca* Spegazzini (1881)	18-20x4.5-5	75-80x10	200-250 diam	------
2. *Aloe* Lucas (1963)	24-27x6-8	88-113x12-14	150-200 diam	20-25
3. *Yucca* Hedjaroude (1968)	18-26x6-8	90-110x12-14	150-250 diam	20-25
4. *Yucca* Shoemaker & Babcock (1985)	17-22x5-6	90-110x11-13	250-350 diam 200-250 tall	17-30
5. *Yucca* NAF 3117, MS) Barr (pers. comm.)	17-20x4.5-5.5	65-80x10-12	220 diam 165-190 tall	20
6. *Smilax* Barr (pers. comm.)	(15-)18-21x5-6	80-90x10	275-550 diam	20-25
7. *Yucca* (BPI 622569) Ramaley	15.2-20.8x4.8-5.6	70.4-84x10.4-11.2	175-225 diam 170-185 tall	20-25
8. *Agave* Ramaley	28.8-36.8x8.8-11.2	128-180x17.6-21.6	250-500 diam	50-80
9. *Nolina* Ramaley	22.4-34.4x8-9.6	136-168x13.6-16	225-325 diam 200-375 tall	20-50
10. *Dasylirion* Ramaley (ined.)	22-26.4x5.6-8	112-144x12-13.6	350-375 long 225-250 wide 200-300 tall	------

The examined conidiomata were overmature, so it could not be determined whether they belonged to *Coniothyrium* or *Microsphaeropsis*. The youngest observed had numerous aseptate conidia with little wall sculpturing, but most conidia were brown, verruculose, 1-septate, and measured 11.2-12.8 x 4.8-7.2 μm (FIG. 3, C). These conidial characters differ somewhat from those of *Coniothyrium henriquesii*, but similarities are stronger than for any collection described above. Conidial sculpturing of the *Coniothyrium* anamorph of *P. obtusispora* is not mentioned by Lucas (1963) or Sivanesan (1984), the conidia are smaller, especially narrower (6-10 x 3-4), than those on *P. obtusispora* BPI 622569, and the conidia are rarely septate on the host, but septate with age in culture (Lucas 1963). Cultures linking *P. obtusispora* BPI 622569 to the accompanying *Coniothyrium* species are not possible, but if this connection is established in future cultures from *Yucca*, and the range of characters include those of *C. henriquesii* as well as anamorphs like that on BPI 622569, *C. henriquesii* can still be considered a phase of *P. obtusispora*. If the teleomorph-anamorph connection on *Yucca* is sufficiently different from that shown on *Aloe*, the fungus on *Yucca* species must be recognized as *P. obtusispora*, for *Yucca* is the host from which *P. obtusispora* was originally described (Spegazzini 1881).

The brown-spored *Coniothyrium* anamorph of *Paraphaeosphaeria* species was a major character separating them from *Phaeosphaeria* species with anamorphs having hyaline conidia in micropycnidia, or brown, septate conidia of the *'Hendersonia'-Phaeoseptoria* form (Eriksson 1967). This distinction no longer applies, for anamorphs of the *Coniothyrium, 'Hendersonia,'* and hyaline microconidial sort all are found in what once constituted a single species of *Paraphaeosphaeria*. A collection from *Nolina micrantha* I. M. Johnst. from the Valley of Fires, Lincoln County, New Mexico included a few ascomata of *Paraphaeosphaeria nolinae* which could not be cultured. Ascomata, asci, and ascospores were morphologically similar to the type of *P. nolinae* from *Nolina erumpens* at a distant location (>300 miles). The two specimens of *P. agavensis* from different species of *Agave*, and collected from distant locations, formed the same anamorph in culture. It appears therefore, that different host genera may be inhabited by particular species of *Parapheosphaeria* with 5-septate ascospores, and that what was considered a single species with many hosts is actually a complex of several different species.

ACKNOWLEDGEMENTS

My thanks to the National Park Service, Big Bend National Park, for permission to collect within the park, and the National Fungus Collections (BPI) for allowing examination of specimens. Appreciation is surely due Mary Palm who realized BPI 1111149 was an unusual *Paraphaeosphaeria obtusispora* and suggested I contact Margaret Barr who had also examined the specimen. Thanks also to Margaret Barr for generously supplying measurements from other collections of *P. obtusispora* which she has examined and for her helpful comments on an early draft of the manuscript, and to Sabine Huhndorf for review of the manuscript and valuable suggestions for improvement.

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MELANOTAEMIUM ADOXAE REVISITED

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Abstract. The rare smut *Melanotaenium adoxae* (Brefeld) S. Ito parasitic on *Adoxa moschatellina* L. is redescribed, illustrated and neotypified from recent collections in Romania. Attempts to germinate ustilospores of *M. adoxae* and *M. ari* were unsuccessful. Due to the dissimilarity in ustilospore morphology, the congenericity of these two species is questioned.

A fungus parasitic on *Adoxa moschatellina* L., collected in Germany, was described as *Ustilago adoxae* Brefeld (1895). This fungus was later found in Romania by Petrescu (1923), and in Japan by Ito (1935). Ito also transferred it to the genus *Melanotaenium* de Bary, under *M. adoxae* (Brefeld) S. Ito, and subsequently provided a description in Japanese and added illustrations of the ustilospores and the attacked host (Ito, 1936).

Although *M. adoxae* was mentioned in numerous publications on Ustilaginales (Zundel, 1953; Săvulescu, 1957; Ciferri, 1963; Buhr, 1964; Brandenburger, 1985; Vánky, 1985; Scholz & Scholz, 1988; Vánky, 1994), it was apparently never collected again. All these authors referred to the collections from Germany, Romania and Japan.

With the exception of Zundel (1953) who examined the type specimen before the Berlin herbarium was destroyed, subsequent authors (Săvulescu, 1957; Ciferri, 1963; Brandenburger, 1985; Vánky, 1985; Scholz & Scholz, 1988; Vánky, 1994) based their descriptions of *M. adoxae* apparently on the one presented by Brefeld (1895).

Besides not being collected in recent times, both the type of *M. adoxae*, and the collection from Japan, are apparently lost (Scholz & Scholz, 1988; Vánky, 1994). Our attempts to locate the specimen recorded from Romania by Petrescu (1923) also remained fruitless.

In efforts to find this rare fungus, one of us (GN) successfully collected it three times, in 1989, 1990 and 1994, in Romania, at the site where its occurrence was reported by Petrescu (1923). Consequently, we provide here a description and illustration based on fresh specimens.

Melanotaenium adoxae (Brefeld) S. Ito (Figs 1-8)

Sori in rhizomes and stolons, appearing first as greyish spots, later as black, shiny swellings, then finally bursting through host tissues and exposing a black mass of ustilospores. *Ustilospores* intercellular, variously shaped, usually polygonal, yellowish to light brown when young, in various shades of brown to almost black when mature, (18–)21·8±2·05(–28) μm long (13–)17·2±1·87(–21) μm wide (*n*=50). In young ustilospores the wall is almost colourless, smooth, and *ca* 0·25 μm thick; in later stages it turns golden yellow to various shades of brown and reaches *ca* 1μm; mature ustilospores are covered by a second, smooth, dark brown wall, of uneven, up to 3 μm thickness.

Specimens examined: On *Adoxa moschatellina* L., Romania, Botoşani Co., Rediu, Rediu Forest, 47°31'47"N 27°14'22"E, alt. 125 m, 25 May 1994, G. Negrean (BUCM 131732 – neotype, UPS – isoneotype); ditto, 25 May 1989, (BUCM 115337); ditto, 1 June 1990, (BUCM 118232, UPS).

Melanotaenim adoxae was found in an association composed of the following plants: *Acer campestre, A. platanoides, Artemisia absinthium, Ballota nigra* subsp. *nigra, Chelidonium majus, Galium aparine, Geranium divaricatum, G. robertianum, Geum urbanum, Lamium maculatum, Lapsana communis, Milium effusum, Polygonatum hirtum, Quercus petraea, Q. robur, Stellaria holostea, S. media* subsp. *media, Viola mirabilis* etc.

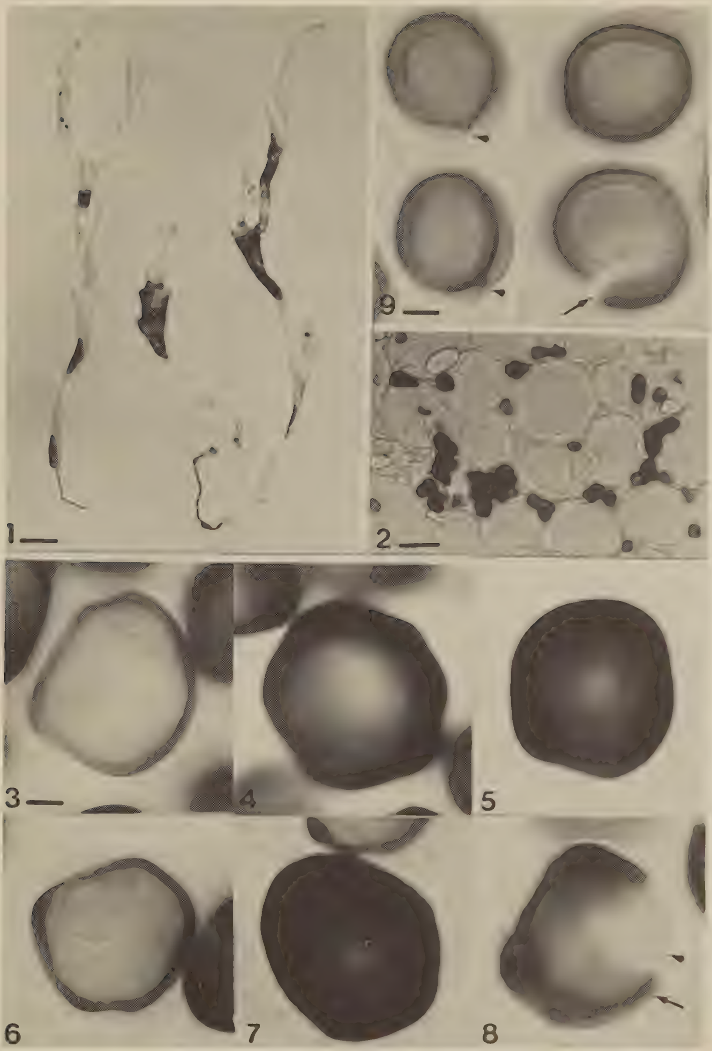
The morphological characters of the specimens of *M. adoxae* found by us completely agree with the description of this fungus provided by Brefeld (1895) and Ito (1936). Because neither the type nor other specimens of *M. adoxae* are available, the specimen BUCM 131732 is here designated as neotype.

Brefeld (1895) described and illustrated germinating ustilospores of *M. adoxae* producing a septate, nonramified hypha. This type of germination is not conclusive to place *M. adoxae* within the Ustilaginales, and no other reports regarding germination in this species are available. Consequently we have attempted to study its germination.

With the intention to simulate conditions in the natural environment, a portion of the neotype collection was dehydrated at room temperature (20-22°C) and preserved at the same temperature between 29 May and 9 Sept. 1994, followed by storage in refrigerator at *ca* 6-8°C. Germination attempts were made after 5 and 9 months cold storage. The ustilospores were liberated from the tissues by pressure applied with a sterilized metal tool and collected in a sterile, deep well slide. The germination tests were carried out in three different conditions: (1) humid atmosphere, by placing the ustilospores in double deep well slides introduced in moist chambers made of Petri dishes, (2) in sterile water as 'hanging drop cultures' in van Tieghem cells, and (3) on culture media, by placing ustilospores on the surface of following agar media: corn meal, corn meal dextrose, 1% malt extract, malt and yeast extracts peptone, and water. The Petri dishes were kept at 20-22°C, in diffuse light, and examined weekly.

No germination was observed during a three month period in any of the tests.

Recently, Preece *et al.* (1994) failed to obtain germination in *M. ari*, parasitic on *Arum maculatum*. They concluded that *M. ari* may be a smut, but that germination studies are essential to elucidate its systematic position. Because a fresh specimen of *M. ari*, collected in Romania (Caraş-Severin Co., Mehedinți Mt., 26 Apr. 1994, G. Negrean, herb. UPS) became available, we have attempted to germinate the ustilospores by using the same procedure as for *M. adoxae*. No germination was obtained but significant differences between the ustilospores of *M. adoxae* and *M. ari* were noticed, particularly when they were incubated for several days in water.



Figs 1-9. *Melanotaenium spp.* 1-8. *M. adoxae*: 1. Stolons showing sori (black portions). 2. Section of stolon showing intercellular ustilospores. 3 & 6. Young ustilospores. 4, 5, & 7. Mature ustilospores. 8. Ustilospore with split outer wall (arrow) and intact inner wall (arrowhead). 9. *M. ari*: Ustilospores showing gelatinous sheath, channel (arrowheads), and split wall (arrow). 1-8. From the isoneotype of *M. adoxae* in UPS. 9. From UPS. Bars = 10 mm for 1; 20 µm for 2; and 5 µm for 3-9.

Thus, in *M. ari* the ustilospore wall is two-layered and covered with a gelatinous sheath (Fig. 9). The inner layer is brownish, 1-1·5 µm thick, whereas the outer layer is darker and *ca* 0·5 µm thick. These two layers have uniform thickness. The sheath has uneven thickness varying from 1·5 to 3 µm. One or two minute channels piercing the sheath are present in some ustilospores. When subjected to pressure both the sheath and the wall layers crack. The structure of the ustilospores as seen in light microscopy is similar to that described in SEM by Preece *et al.* (1994). In *M. adoxae* the inner wall is uniformly thick, the outer one is uneven, and there is no sheath present. Although the outer wall is frequently fractured, the inner wall will remain intact (Fig. 8). The differences in ustilospore structure of *M. adoxae* and *M. ari* suggest that these two fungi possibly belong to different genera.

In the absence of reliable and detailed information concerning the germination pattern, ultrastructure and/or molecular studies, the placement of *M. adoxae* within *Ustilaginales* may be questioned. Brefeld (1895) himself was even not sure that his fungus belongs to *Ustilago* and, consequently, added a question mark after the generic epithet. Ciferri (1963) doubted that it is a *Melanotaenium*. Nevertheless, the symptoms produced on the host plant and the overall morphology of the ustilospores are suggestive of *Ustilaginales*.

Acknowledgements. We thank Dr. J.E.M. Mordue for constructive criticism as a prereviewer and for drawing attention to, and providing a copy of the paper by Ito (Ito, 1936), and Mrs Ulla-Britt Sahlström for printing the photographs.

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NOTES ON HYPHOMYCETES. LXXIII. REDESCRIPTION OF PHAEORAMULARIA COALESCENS, PHAEORAMULARIA EUPATORII-ODORATI AND PHAEORAMULARIA PRUNI

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ABSTRACT

Three species of *Phaeoramularia* Muntañola, *P. coalescens* (Davis) Braun, *P. eupatorii-odorati* (Yen) Liu & Guo, and *P. pruni* Guo & Liu, are redescribed and illustrated from type and other material. Comments are made on the relative distinctiveness of the respective taxa.

INTRODUCTION

During the course of recently naming and describing a number of novel species of *Phaeoramularia* from the Indian subcontinent (Singh, Chaudhary and Morgan-Jones, 1995, 1996), occasion has arisen to compare the new taxa with various others previously described, in order to ascertain their uniqueness. This has afforded an opportunity to study specimens of a number of species, several of which have not, to date, been comprehensively described and illustrated in the literature. Type material of some of these taxa has been examined. As a contribution to our knowledge of the genus and understanding of species delineation, modern redescriptions and new illustrations of three such entities are published herein.

TAXONOMIC PART

Phaeoramularia coalescens (Davis) Braun & Rogerson, *Mycotaxon* 46: 264, 1993 (Figure 1).

≡ *Cercospora coalescens* Davis, *Trans. Wis. Acad. Sci.* 15: 780, 1907.

≡ *Ramularia coalescens* (Davis) Pirozynski, *Fungi Canadense* 23, 1974.

= *Graphiothecium vinosum* Davis, *Trans. Wis. Acad. Sci.* 18: 90, 1915.

Leaf lesions amphigenous, somewhat irregularly-shaped, more or less orbicular at first when small, spreading to become angular and often vein limited, gregarious and sometimes becoming confluent although remaining discernible as individual entities by margin coloration, pale reddish brown to reddish brown on the adaxial surface, with a distinct, narrow, darker margin, appreciably paler on the abaxial surface. Mycelium immersed in the leaf tissue, composed of hyaline to subhyaline, septate, branched, smooth, 2.5-3µm wide hyphae. Caespituli hypophyllous, punctiform, scattered more or less evenly over the leaf lesions, brownish. Stromata substomatal, pseudoparenchymatous, moderately well-developed, subglobose, pale olivaceous, up to 35µm wide. Conidiophores arising from the cells of the stromata, emerging through stomata, semi-macronematous to macronematous, mononematous, fasciculate, usually in large, dense fascicles of up to twenty, simple, flexuous, smooth, cylindrical, becoming geniculate distally following sympodial growth associated with conidium production, usually 1-septate, olivaceous, 18-64 X 3-4.5µm. Conidiogenous cells integrated, terminal, polyblastic, sympodial, cicatrized, bearing thickened, conspicuous, refractive scars, up to eight in number. Conidia holoblastic, acropleurogenous, dry, catenulate, occasionally anastomosing or producing a secondary condium laterally, subcylindrical to narrowly ellipsoid, straight or slightly curved, obtuse at the apex where terminal, smooth, subhyaline to pale olivaceous, 0 to 1-septate, bearing one or more moderately-thickened hila, 18-48 X 2.5-5µm.

On living leaves of *Ribes* spp. (Grossulariaceae); North America.

Collection examined: on *R. bracteosum* Dougl., Portland, Oregon, U.S.A., July 12, 1905, J.J. Davis, WIS, holotype.

Phaeoramularia coalescens is known to occur on a number of species of *Ribes* L. It was originally described as follows from a collection made on *R. bracteosum* in Oregon (Davis, 1907); "Spots reddish-brown above with a narrow dark border; paler beneath, round or angular, 3-8mm. in diameter, sometimes confluent; hyphae hypophyllous, sub-hyaline, continuous, straight or somewhat flexuose, forming minute gray or brownish-gray tufts; conidia hyaline, continuous, cylindrical, 20-40 X 3 microns.". The same author (Davis, 1915) described a different form of what is apparently the same fungus, on *Ribes americanum* Mill. [= *R. floridum* L'Her], the American black currant, in Wisconsin. This was described as follows: "Spots angular, limited by veinlets, often confluent into irregular areas, brown, 2-5 mm. in diameter; conidiophores

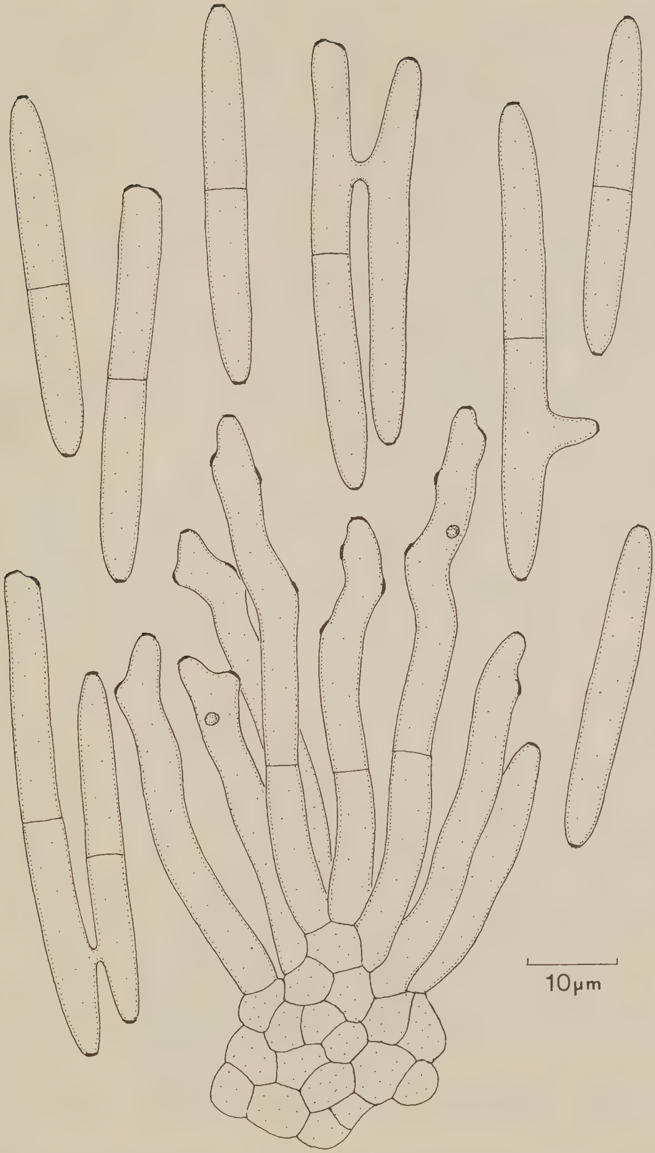

FIGURE 1. *Phaeoramularia coalescens*. Stroma, conidiophores and conidia.

hypophyllous in scattered tufts, closely fasciculate from a prominent sclerotioid base, hyaline, often toothed, 30-65 X 2-3 µm; conidia terminal and lateral, hyaline, cylindrical, abruptly acute or rounded at each end, occasionally with a median septum, 20-50 X 3-4µm. The tufts usually have more or less of a pink tinge. Large fasciculi have a marked stilboid appearance.". Following outdoor overwintering of leaves bearing the fungus its morphology was found to differ even further, with the conidiophores compacted into blackish "stipes", arising from a "plectenchymatous pseudopycnidium", and bearing conidial "heads". The conidia were reported to be 10-18 X 3µm in diameter in this material and the form of the caespituli to vary to ones more "tubercularoid" in shape. On account of the coremium-like conidiophore arrangement the name *Graphiothecium vinosum* was applied to this manifestation. It is evident that *P. coalescens* can vary morphologically and in degree of development, depending upon environmental and seasonal conditions. Its usual phenotypic expression during the season of infection presumably approximates the description provided above.

Phaeoramularia coalescens appears to be a rather common leaf spot-inducing pathogen of *Ribes* species in some areas. Greene (1944, 1966) reported it to occur on *Ribes glandulosum* Grauer [= *R. prostratum* L'Her] and *R. americanum*, respectively, in Wisconsin. Cooke (1967) again reported it on *R. bracteosum* from Oregon. Shaw (1973) noted the occurrence of a *Ramularia* species on *Ribes hudsonianum* Richardson [= *R. petiolare* Douglas], *R. lacustre* (Pers.) Poir., and *R. sanguineum* Pursh [= *R. wolfii* Rothr.] in Washington, as well as on *R. bracteosum* in that state and in Oregon. It seems likely that these reconds are of *Phaeoramularia coalescens*. Anon (1960) listed *P. coalescens* on *Ribes* sp. in Wisconsin and Washington, and an unspecified *Ramularia* species causing a leaf spot of a *Ribes* sp. in Michigan. Again, it seems probable that the latter record is of *P. coalescens*. This species was briefly described by Braun and Rogerson (1993) from a collection on leaves of *Ribes inerme* Rydb. [= *R. divaricatum* Douglas var. *inerme* (Rydb.) McMinn] made in Utah. Conidiophore and conidial dimensions of 10-70 X 2-5µm and 15-40 X 2.5-5µm, respectively, were reported. Because of the pale olivaceous coloration of stromata and conidiophores this taxon was considered by these authors to be more appropriately classified in *Phaeoramularia*, rather than in *Ramularia* Unger, where Pirozynski (1974) had placed it. This taxonomy is concurred with herein. The fungus is the only species of *Phaeoramularia* known to occur on its host phanerogamic plant family.

Phaeoramularia eupatorii-odorati (Yen) Liu & Guo, *Acta Phytopath. Sin.* 12: 7, 1982 (Figure 2).

≡ *Cercospora eupatorii-odorati* Yen, *Bull. trimest. Soc. mycol. Fr.* 84:11, 1968.

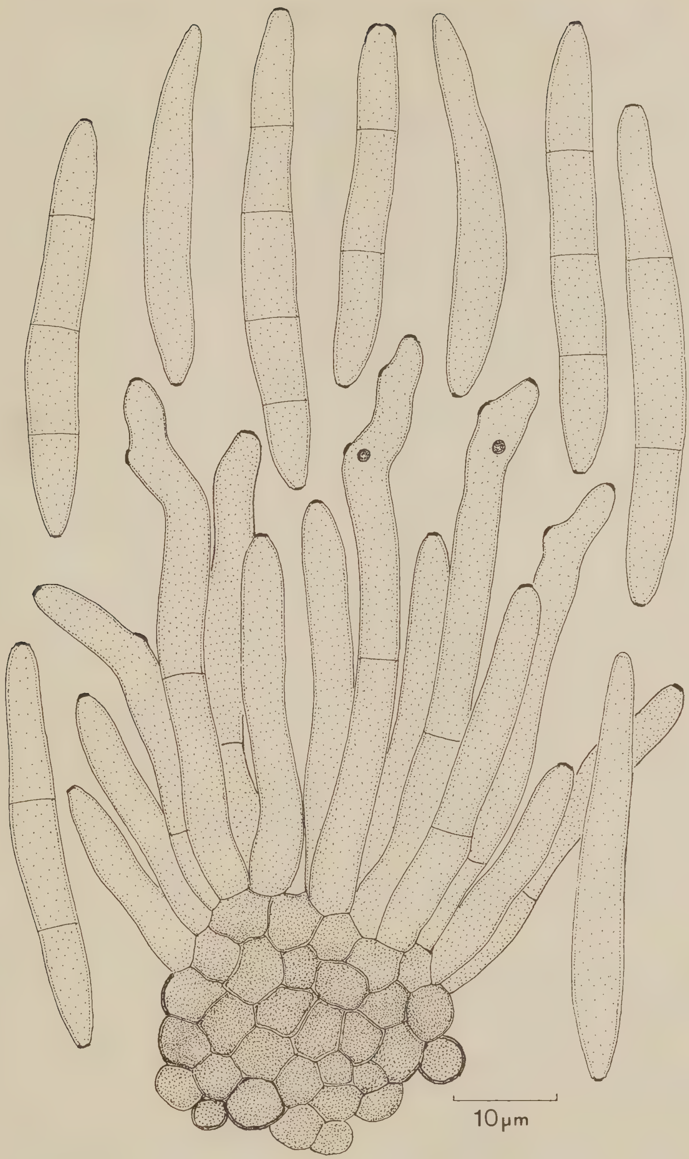

FIGURE 2. *Phaeoramularia eupatorii-odorati*. Stroma, conidiophores and conidia.

≡ *Mycovellosiella eupatorii-odorati* (Yen) Yen, *Bull. trimest Soc. mycol. Fr.* 97: 131, 1981.

Leaf lesions amphigenous, mostly small, orbicular to suborbicular, pale brown, more or less evenly-colored but with a narrow, distinctly darker margin, somewhat paler on the abaxial surface, usually about 2mm, but occasionally up to 5 mm in diameter. Mycelium mostly immersed in the leaf tissue but with some hyphae assuming a superficial habit, composed of subhyaline to very pale brown, septate, branched, smooth, 2-3.5μm wide hyphae. Aerial hyphae subhyaline, 2-2.5um wide. Caespituli amphigenous, punctiform but sometimes assuming a somewhat coremium-like appearance, scattered, more or less evenly distributed over the leaf lesions, brown to dark brown. Stromata substomatal, pseudoparenchymatous, subglobose, usually well-developed, mid brown, up to 50μm wide, composed of isodiametric, pale to mid brown, up to 7μm wide cells which become appreciably thick-walled when mature. Conidiophores arising from the upper and outer cells of the stromata and emerging through stomata, or very occasionally as short, lateral branches of aerial hyphae, semimacronematous to macronematous when originating from stromata, mononematous, fasciculate, often tightly arranged in dense fascicles of up to forty-five, simple, flexuous, smooth, cylindrical, sometimes becoming slightly geniculate distally as a result of sequential conidiation, continuous or 1-septate or, more rarely, 2-septate, pale brown, becoming somewhat darker with age, 18-80 X 3-5μm. Fertile lateral branches of superficial hyphae, which function as conidiophores, up to 22um in length, 3-4.5um wide. Conidiogenous cells integrated, terminal, monoblastic or, more frequently, polyblastic, mostly sympodial, cicatrized, bearing thickened, conspicuous, refractive, 1.5-2μm wide scars; usually two to five in number. Conidia holoblastic, acropleurogenous, dry, catenulate, in simple or branched chains, subcylindrical to broadly fusiform, more or less straight or, more usually, very slightly curved, obtuse at the apex where terminal, otherwise narrowly subtruncate at each end, pale olivaceous brown, smooth, 0 to 4-septate, bearing one or more moderately thickened, 1-1.5μm wide hila, 15-60 X 2.5-5μm.

On living leaves of *Ageratina adenophora* (Speng.) R.M. King &H. Robinson, *Eupatorum adenophorum* L., and *Eupatorum odoratum* L. (Asteraceae); China, New Zealand and Southeast Asia.

Collection examined: on *E. odoratum*, Puer, Yunnan Province, China, August 6, 1973, X. Liu and Y. Zong, HMAS 42408.

Phaeoramularia eupatorii-odorati was originally described, as *Cercospora eupatorii-odorati*, from a collection made in Malaysia (Yen, 1968). The same author subsequently altered its taxonomy by reclassifying the fungus in *Mycovellosiella* Rangel on account of the presence of

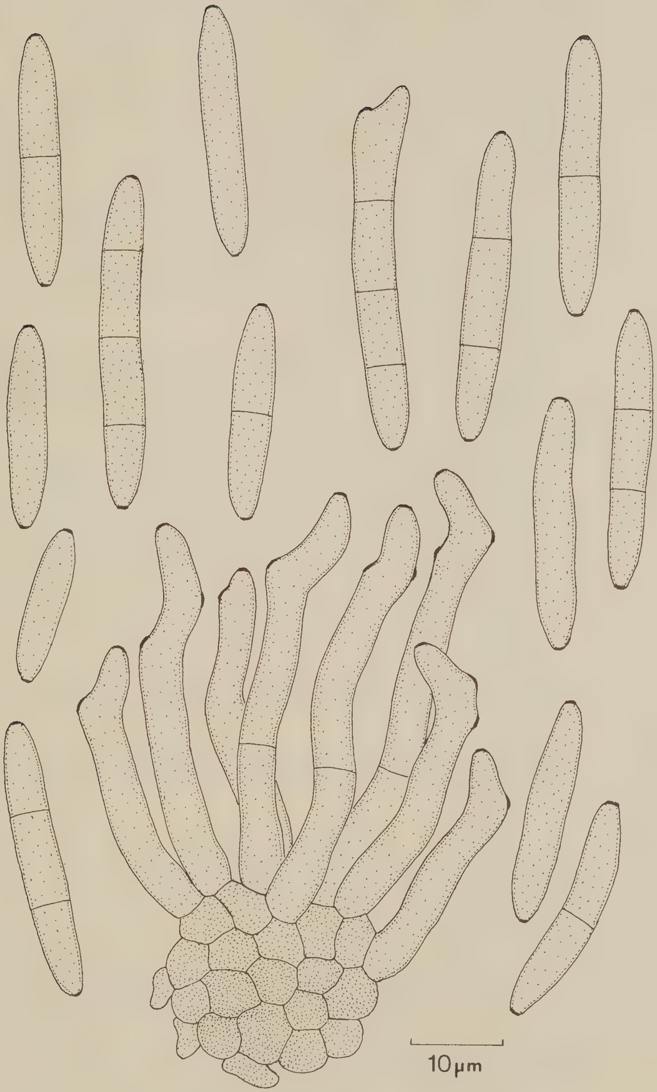

FIGURE 3. *Phaeoramularia pruni*. Stroma, conidiophores and conidia.

fertile, superficial hyphae, as well as conidiophore-bearing stromata. The occurrence of such hyphae is not, however, considered to be sufficiently significant to warrant this classification since *P. eupatorii-odoratii* is otherwise quite typical of *Phaeoramularia*, as characterized by its type species, *P. gomphrenicola* (Speg.) Muntañola. Its transfer into that genus by Liu and Guo (1982) is therefore accepted. The inclusion in the related genus *Ramularia* Unger, by Braun (1990) and Srivastava et al. (1995), of species having either immersed stromata or producing conidiophores from external mycelium reflects the view that this type variation is not deemed an adequate reason for the classification of such taxa in different genera. At least ten species currently classified in *Ramularia*, six of which had previously been placed in *Mycovellosiella* (Deighton 1974, 1979), lack stromata such as are produced by most species but have conidiophores and conidia that are typical of the genus.

Phaeoramularia eupatorii-odorati has something of the aspect morphologically, particularly in conidial shape, of a species such as *P. ajrekari* (Syd.) Deighton [*Cercospora ajrekari* Sydow], which occurs on leaves of *Jatropha nana* Dalz. & Gibs., a member of the Euphorbiaceae, in Poona, India (Sydow, 1914). It is also similar to that taxon in conidiophore and conidium dimensions, as well as in having dense fascicles made up of numerous conidiophores. It differs, however, in conidiophore length and in degree of stromal development and pigmentation. Although many species of *Phaeoramularia* are, as is the case in a number of closely related genera of the *Cercospora*-complex, quite similar, small differences in the finer details of morphology, and in the dimensions of the structures associated with conidiation, in addition to host specificities, serve to distinguish them. Conidiophore dimensions, of course, can be expected to vary in different collections. Conidiophore length of *P. eupatorii-odorati*, for example, was reported by Yen (1968) to be appreciably larger than in the collection on which the description of Liu and Guo (1982), and that contained herein, are based.

Singh et al. (1995) described *Phaeoramularia nepalensis* Singh & Chaudhary from a collection made in Nepal on living leaves of *Eupatorum adenophorum*, a host which *P. eupatorii-odorati* is known to occur on in New Zealand (McKenzie, 1990). Although bearing some similarity to *P. eupatorii-odorati*, *P. nepalensis* produces conidia that are readily distinguishable in shape and septation. *Phaeoramularia eupatorii-odorati* has also been reported from New Zealand on *Ageratina adenophora* (McKenzie, loc. cit.) and it may occur on this host in South Africa, although this needs to be confirmed. An unnamed *Phaeoramularia* reported on this plant in that country (Morris, 1989) might well be *P. eupatorii-odorati*.

Phaeoramularia pruni Guo & Liu, *Acta Mycol. Sin.* 6: 226, 1987 (Figure 3).

Leaf lesions amphigenous, more or less orbicular, at first appearing as small, well-defined, evenly-colored, purplish-brown, 1 to 2mm wide spots, later becoming progressively paler centrally and eventually assuming a pale yellowish-brown to buff coloration with the extreme margin remaining brown, up to 4mm in diameter, with little difference in color when viewed from either the adaxial or abaxial surfaces. Mycelium immersed in the leaf tissue, composed of hyaline to subhyaline, septate, branched, smooth, 2-2.5μm wide hyphae. Caespituli amphigenous but mostly hypophyllous, punctiform, brownish, usually few in number. Stromata substomatal, pseudoparenchymatous, subglobose, moderately well-developed, pale to mid brown, up to 40μm wide. Conidiophores arising from the cells of the stromata, emerging through the stomata, macronematous, mononematous, fasciculate, usually in fascicles of between eight and fifteen, simple or sometimes branched, flexuous, smooth, cylindrical, often somewhat geniculate, 0 to 1-septate or, more rarely, 2-septate, olivaceous-brown, 10-55 X 3-5μm. Conidiogenous cells integrated, terminal, polyblastic, sympodial, cicatrized, bearing thickened, refractive, 1.5-2μm wide scars, up to seven in number but mostly two to four. Conidia holoblastic, acropleurogenous, dry, catenulate, in simple or, occasionally, branched chains, cylindrical, straight or very slightly curved, obtuse at the apex when terminal, subhyaline to pale olivaceous, up to 3-septate, predominantly 0 to 1-septate, bearing one or more moderately-thickened hila, 15-40 X 2-4.5μm.

On living leaves of *Prunus* sp. (Rosaceae); China.

Collection examined: on *Prunus* sp., Shennongjia, Hubei Province, China, August 8, 1984, Y-L. Guo, HMAS 50588, holotype.

Two other species of *Phaeoramularia* have recently been described on members of the Rosaceae, namely *P. pyricola* S.K. Singh & R.K. Chaudhary and *P. pyrigena* S.K. Singh & R.K. Chaudhary (Singh et al., 1995, 1996), which occur in Nepal on *Pyrus communis* L. and *Pyrus pashia* Bush.-Ham, respectively. Although these species, together with P. pruni, have a number of morphological similiarities, all three are readily distinguishable by conidial dimensions and degree of conidial septation. There are also small differences in their individual morphology and symptomatology. *Cercospora rubro-tincta* Ell. & Everh., which causes reddish to reddish-brown leaf spots on *Prunus dulcis* (Mill.) D. Webb [= *Prunus amygdalus* Batsch], is a different fungus.

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PERTUSARIA VELATA (TURNER) NYL. AND ITS SYNONYMS

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ABSTRACT: The synonymy and distribution of *Pertusaria velata* (Turner) Nyl. is reported and discussed.

Pertusaria velata (Turner) Nyl. is one of the earliest members of the genus *Pertusaria* to have been described and was originally published, as *Parmelia velata* Turner (Turner 1808). The species is recognised as having a wide distribution (Dibben 1980; Hanko 1983; Purvis et al. 1992) and has been reported from all five continents:

Europe: Ireland, Germany, France, Italy, Portugal (Hanko1983), United Kingdom and Sweden, (Purvis et al. 1992).
Asia: China (Zahlbruckner 1930: 146), India & Sri Lanka (Awasthi 1991), Indonesia (Zahlbruckner & Mattick 1957) , Japan & Taiwan (Oshio 1968), Korea (Huneck et al. 1994).
America: Brazil, (Krempelhuber 1876), Paraguay (Malme 1936), Uruguay (Räsänen 1938), Hawaii (Magnusson 1955), Argentina (Ferraro 1978), U.S.A. & Canada (Dibben 1980).
Africa: South Africa (Stizenberger 1890), Sierra Leone (Müller 1893).
Australasia: New Caledonia (Nylander 1868), Australia (Shirley 1889), New Zealand (Archer & Elix 1994), Papua New Guinea (Archer, Elix and Streimann 1995).

Additional locations are listed under *Pertusaria velata, vide infra.*

In addition to *Pertusaria velata*, a number of morphologically similar species have been reported from the same areas. The protologues to these species often contain references to, or comparisons with, *Pertusaria velata* and the species are differentiated from *Pertusaria velata* by reference to a variable or inconstant feature such as spore size, size of apothecial disc or the presence or absence of lichexanthone. An examination of most of the relevant type specimens has shown them to be indistinguishable from *Pertusaria velata* and they are here reported as synonyms. Additional synonyms are reported elsewhere (Erichsen 1936, Oshio 1968, Dibben 1980). The chemistry of the specimens examined was determined by thin layer chromatography (Elix & Ernst-Russell 1993) and liquid chromatography (Feige et al. 1993). The spore sizes and chemistry of the synonymous taxa are listed in Table 1.

Pertusaria velata (Turner) Nyl., Lich. Scand.: 179 (1861).

Parmelia velata Turner, Trans. Linn. Soc. London 9: 143 (1808).

Type: England, Sussex, no locality, on ash trees, *W. Borrer s.n.*, 1805; holotype: BM.

Hanko reported the holotype to contain lecanoric acid only whereas specimens from Portugal contained additional lichexanthone (Hanko 1983: 66). Harris suggested that lichexanthone was present in subtropical/tropical taxa but absent in morphologically similar taxa from temperate/boreal areas. Consequently he maintained *Pertusaria velata* and *Pertusaria pulchella* (both of which occur in Florida) as separate species (Harris 1990). *Pertusaria velata* from the South Island of New Zealand, another temperate region, contained only lecanoric acid when examined by liquid chromatography (Archer & Elix 1994).

Specimens examined:

CHILE, Prov. de Coquimbo, Parque Nacional de Fray Jorge, Altos de Talinay, bajando a Caleta Ramadita, *L. Ferraro & J. Redón*, 17.v.1980 (CTES 2149).

FIJI, Kadavu Island, near "Alberts Place", on tree near beach, *R. Poulsen s.n.*, 26.xi.1995 (NSW).

NORFOLK ISLAND, Mt. Pitt Reserve, 29°00'30"S, 167°56"E, alt. 100 m, on *Araucaria heterophylla*, *J.A. Elix 18716*, 8.xii.1984 (CANB).

VANUATU [as New Hebrides], on coconut palm, *F.R.M. Wilson s.n.*, 1895 (NSW).

SYNONYMS:

Pertusaria commutans Vainio, Ann.Univ.Fenn. Aboënsis, Ser. A,II,3: 4 (1926).

Type: South Africa, Knysna, *P. van der Bijl 282*, 1921; holotype: TUR-V 3442!

Although Vainio (loc.cit.) compared this species with *Pertusaria velata,* he reported it to react K+ weak yellow, C- and KC+ weak yellow. An examination of the holotype revealed the presence of lichexanthone and lecanoric acid.

Pertusaria pulchella Malme, Arkiv för Botanik 28A: 6 (1936).

Type: Brazil, Rio Grande do Sul, Cachoeira, *G. Malme 1074*, 21.ii.1893; holotype: S!

Malme (*loc. cit.*) reported the thallus of this species to be C + red and an examination of the type specimen showed the presence of lichexanthone and lecanoric acid.

Pertusaria rhodotropa Müll.Arg., Bull.Herb.Boissier 3: 637 (1895).
Type: Australia, Queensland, s.loc., *C. Knight 308 p.p.*; lectotype: G! [A.W. Archer, Telopea 4: 181 (1991)]
Müller (*loc. cit.*) did not report any chemical tests on this species but the lectotype was found to contain lichexanthone and lecanoric acid.

Pertusaria santamonicae Dibben, The chemosystematics of the lichen genus *Pertusaria* in North America north of Mexico: 67 (1980).
Type: U.S.A., California, Los Angeles County, Santa Monica Mountains, no locality, on various barks, *Hasse 213*; holotype: WIS; isotype: NSW!
Dibben (*loc. cit.*) reported lichexanthone and lecanoric acid for this species and distinguished it from *Pertusaria velata* by the presence of this xanthone.

Pertusaria skottsbergii Zahlbr., The Natural History of Juan Fernandez and Easter Island. Vol.II, Botany: 377 (1924).
Type: Chile, Juan Fernández Islands, Masatierra, on smooth bark, *C. & I. Skottsberg*; holotype: GB!
Zahlbruckner reported the thallus and discs to be C+ red and chemical examination showed the presence of lichexanthone and lecanoric acid.

Pertusaria subvaginata Nyl., Flora 49: 290 (1866).
Type: Nova Granata [Colombia], *Lindig 2658*; holotype: H-NYL 23508!
Nylander (loc.cit.) reported this specimen to be "apoth. K(CaCl) eryth.", i.e. KC+ red and examination of a paratype showed the presence of lichexanthone and lecanoric acid (K.Kalb in litt.).

Pertusaria subvelatula Vainio, Ann.Univ.Fenn. Aboënsis, Ser. A,II,3: 3 (1926).
Type: South Africa, Natal, Howick, on *Acacia mollisima, P. van der Bijl 203*, 1920; holotype: TUR-V 34425!
Although Vainio (loc.cit.) compared this species with *Pertusaria velata,* he reported it to react K- and C- but KC+ red, suggesting the presence of picrolichenic acid. However, an examination of the holotype revealed the presence of lichexanthone and lecanoric acid.

Specimens of the following two species from Hawaii were not seen but from their descriptions both resemble *Pertusaria velata* and are possible synonyms.

Pertusaria hawaiiensis Erichs. in Fedde Repert. Spec. Nov. Regni Veg. 41: 93 (1936).
Type: Hawaii, Mauna Loa (*fide* Magnusson, *loc. cit.*).

In his key to the Hawaiian *Pertusaria*, Magnusson (1955) reported *Pertusaria hawaiiensis* to react C+ red.

Pertusaria contraria Magnusson, Ark. Bot., ser. 2, 3: 332 (1955).
Type: Hawaii, Hilo, 1880, *E. Bailey* per *Dr. Eckfeldt 178*, on smooth bark (*fide* Magnusson, *loc. cit.*).

Magnusson (*loc. cit.*) also reported this species to react C+ red.

TABLE 1

REPORTED SPORE SIZES AND CHEMISTRY OF *PERTUSARIA VELATA* AND ITS SYNONYMS.

Species	Spore size (μm)	Chemistry [All contain lecanoric acid]
P. velata	120-315 x 31-97	± lichexanthone
P. commutans	124-164 x 28-46	+ lichexanthone
P. contraria	300-325 x 70-100	?
P. hawaiiensis	134-236 x 38-56	?
P. pulchella	180-215 x 50-60	+ lichexanthone
P. rhodotropa	110-175 x 30-45	± lichexanthone
P. santamonica	124-223 x 24-72	+ lichexanthone
P. skottsbergii	170-220 x 45-80	+ lichexanthone
P. subvaginata	150-166 x 53-62	+ lichexanthone
P. subvelatula	125-160 x 30-37	+ lichexanthone

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EXOPERIDIUM AND SPORES OF *CALVATIA UTRIFORMIS*

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ABSTRACT

According to the consulted literature, the species *Calvatia utriformis* is separated into three varieties, one of them known only from the type locality. Comparisons of the different kinds of exoperidium, spores and capillitium illustrate that the three varieties are not clearly distinguished.

Key words: *Gasteromycetes*, *Calvatia*, exoperidium, spores, morphology, taxonomy.

RESUMEN

De acuerdo con la literatura consultada, la especie *Calvatia utriformis* es separada en tres variedades, una de ellas conocida únicamente de la localidad tipo. La comparación entre los diferentes tipos de exoperidio, esporas y capilicio demuestran que las tres variedades no pueden ser diferenciadas con claridad.

Palabras clave: *Gasteromycetes*, *Calvatia*, exoperidio, esporas, morfología, taxonomía.

INTRODUCTION

Within the species of *Calvatia* Fr. that have subgleba, *C. utriformis* (Bull.: Pers.) Jaap is the most frequent all over the world (KREISEL, 1989). The spores in this species are smooth or punctate; whereas in others species with subgleba, the spores are finely echinulate - *C. lloydii* Zeller & Coker - or verrucose - *C. cretacea* (Berk.) Lloyd.

According to KREISEL (1989) the exoperidium ornamentation and the spores are enough features to separate *C. utriformis* into three varieties:

- C. *utriformis* (Bull.: Pers.) Jaap var. *utriformis*: exoperidium formed by flat or pyramidal warts and spores practically smooth, under the light microscope (LM).
- C. *utriformis* (Bull.: Pers.) Jaap var. *hungarica* Hollós : with the same exoperidium as in the type variety and spores smooth or punctate, under the LM.
- C. *utriformis* (Bull.: Pers.) Jaap var. *gruberi* A.H. Smith (known only from the type locality): exoperidium composed of connivent spines and smooth spores, under the LM.

In Catalonia, *C. utriformis* grows in both lowlands and hilly regions up to 2000 m (MARTIN, 1988). As in other *Gasteromycetes* the different environmental conditions in which the fruit-bodies mature can induce an important variability in the development and formation of the peridium ornamentation (DEMOULIN & LANGE, 1990), as well as in the spore ornamentation (DEMOULIN, 1971). The main purpose of this work is to compare the exoperidium and the spores observed in some collections in order to maintain or reject the three varieties.

MATERIAL STUDIED

The material studied has been deposited in the Herbarium of the Department of Biologia Vegetal (Botany), Barcelona University (BCC).

We have re-examined the samples published in MARTIN (1988), whose herbarium numbers are BCC-MPM 54, BCC-MPM 206, BCC-MPM 272, BCC-MPM 349, BCC-MPM 438, BCC-MPM 439, BCC-MPM 480, BCC-MPM 481, BCC-MPM 494.

The new collections examined are the following:

Barcelona: Parc del Corredor (Vallès Oriental), 350-400 m, 31TDG50, mixed forest with *Erica arborea* and *Cistus monspeliensis*, 25.10.1984, leg. M.P. Martín, BCC-MPM 80.

Girona: Molló (Ripollés), 1200 m, 31TDG58, 12.7.1992, leg. J. Sanchez, BCC-MPM 1636; Setcases (Alt Empordà), 31TDG49, green grassy area, 3.10.1992, leg. J. Sanchez, BCC-MPM 1638; Matagalls (La Selva), 1145 m, 31TDG42, green grassy area with *Pteridium aquilinum*, 28.5.1993, BCC-MPM 1670.

Lleida: Riera de Cardós (Pallars Sobirà), 900 m, 31TCH51, 11.1991, leg. J. Lara Ruiz, BCC-MPM 1536; Tabescán (Alt Urgell), 1600 m, 31TCH52, under *Betula* sp., 7.7.1993, leg. J. Sanchez, BCC-MPM 1679.

Huesca: Parador de Pineta, Parque Nacional de Ordesa y Monte Perdido, 31TBH62, green grassy area, 17.10.1989, leg. J. Llistosella, BCC-MPM 1183; Torlarribera, 2000 m, 30T-31TDG99, green grassy area, 10.7.1990, leg. J.M. Ninot, BCC-MPM 1314; Torlarribera, 1000 m, 30T-31TDG99, green grassy area, 1992, leg. J.M. Ninot, BCC-MPM 1634; *Idem*, 12.7.1992, leg. J.M. Ninot, BCC-MPM 1635.

Oviedo: Bulnes, Careña, 30TUN58, green grassy area, 13.5.1990, leg. M. Aguasca, BCC-MPM 1232.

We have also studied collections from the herbaria, BRNO (Brno, Czech Republic), LG (Liège, Belgium) and MICH (Michigan, USA). These samples are:

Czech Republic: Kurím, *Picea excelsa*, 10.2.1951, leg. et det. F. Smarda as *Calvatia caelata* Bull. f. *hungarica* (Hollós) Smarda (BRNO 40213).

France: Pyrénées-Orientales, à l'w du Pic Neulos (au S de Sorède à la frontière espagnole), 1200 m, pelouse pseudo-alpine, 19.6.1975, leg. V. Demoulin (LG, slide BCC-MPM 1279); Pyrénées-Orientales, La Bastide (carte XXIV-49-5-6), Les Espinassets, 1100 m, lande rocheuse pâturée, 7.1978, leg. P. Pescheur (LG, slide BCC-MPM 1280).

USA: Oregon, Near Mt. Hood, Clackamas Co., under scattered conifers, 1945, leg. W.B. Gruber 754, det. A.H. Smith as *Calvatia tatrensis* Hollós var. *gruberi* A.H. Smith (Holotype, MICH).

RESULTS AND DISCUSSION

LANGE (1990) studied some collections of *Calvatia utriformis* from Iceland. According to his description, the exoperidium in those samples is composed of groups of connivent spines like in samples BCC-MPM 1183, BCC-MPM 1232, BCC-MPM 1634 and BCC-MPM 1679 (Fig. 1 a-b). Microscopically the exoperidium is formed by groups of sphaerocists arranged in rows forming the spines (Fig. 1 c).

In agreement with CALONGE & DEMOULIN (1975) a great number of samples from our herbarium have the exoperidium formed by little pyramidal warts, which break away at maturity leaving the exoperidium areolate (BCC-MPM 54, BCC-MPM 80, BCC-MPM 206, BCC-MPM 272, BCC-MPM 349, BCC-MPM 438, BCC-MPM 439, BCC-MPM 480, BCC-MPM 481, BCC-MPM 494, BCC-MPM 1536, BCC-MPM 1636, BCC-MPM 1638, BCC-MPM 1670). This is the same kind of ornamentation observed in collections from France (Fig. 1 e-f), as well as in *C. utriformis* var. *hungarica*, and it is formed by inflated cells mixed with short hyphae.

The holotype of *C. utriformis* var. *gruberi*, has an exoperidium with both kinds of ornamentation: connivent spines over the upper portion of the fruit-body and, on the lower part, little pyramidal warts (Fig. 1 d). Spores viewed with the light microscope are smooth. However, the scanning electron microscope shows that they are ornamentated with rounded warts (Fig. 3 e, f, g). This is the same kind of ornamentation observed in *C. utriformis* var. *hungarica* (Kreisel, 1989 -fig.3). As mentioned above, the variety *gruberi* is known only from the type locality. Kreisel (1989) did not study the holotype. In our opinion these two varieties belong to the same taxon.

Two samples in the Spanish collections, BCC-MPM 1314 and BCC-MPM 1635, have an exceptional exoperidium formed by prominent pyramidal warts which rise to a height of 12 mm (Fig. 2 a-b) and are formed by clusters of sphaerocists combined with hyphae (Fig. 2 c). Due to the presence of this strong ornamentation, we thought first that they could belong to the group of *C. sculpta* (Hark.) LLoyd. However, both samples have smooth spores, under the LM and the capillitium formed by hyphae with slitlike pores (Fig. 2 d), whereas *C. sculpta* has spores with very minute spines (up to 0.25 mm high) and the walls of the capillitium hyphae have rounded pores (ZELLER & SMITH, 1964).

Under the scanning electron microscope, some spores of sample BCC-MPM 1314 are smooth (Fig. 3 a), but others present different degrees of ornamentation (Fig. 3 b, c), as illustrated in KREISEL (1989 -fig. 4) for *C. utriformis* var. *utriformis*. But, on the other hand, Fig. 3 b and Fig. 3 c show the same kind of spore ornamentation as some of the spores of *C. utriformis* var. *hungarica* (KREISEL, 1989 -fig. 3)

Due to the fact that samples can not be separated using the ornamentation of the exoperidium or the kind of spores, we think that there is not sufficient reason to maintain the three varieties of *C. utriformis* (Bull.: Pers.) Jaap.

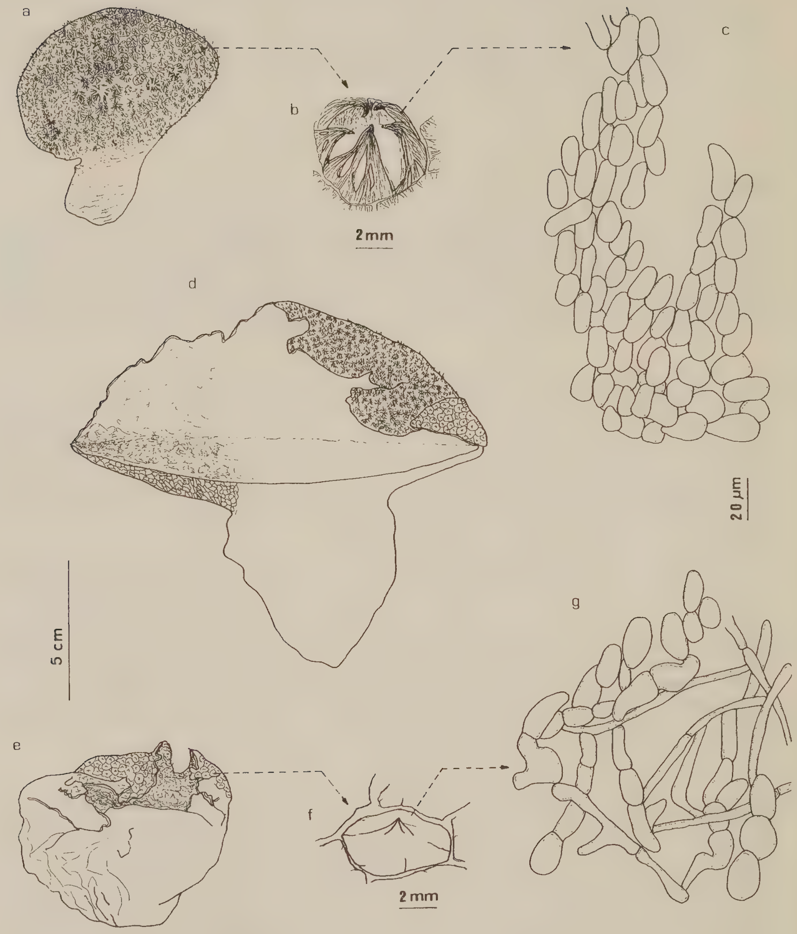

Fig. 1. *Calvatia utriformis*, BCC-MPM 1679 (a-c). a: fruit-body; b: connivent spines; c: sphaerocysts.- *C. utriformis* var. *gruberi*, HOLOTYPE (d). d: half part of the fruit-body deposited in MICH herbarium.-*C. utriformis* (LG, slide BCC-MPM 1279) (e-g). e: fruit-body; f: pyramidal wart, g: sphaerocysts and hyphae.

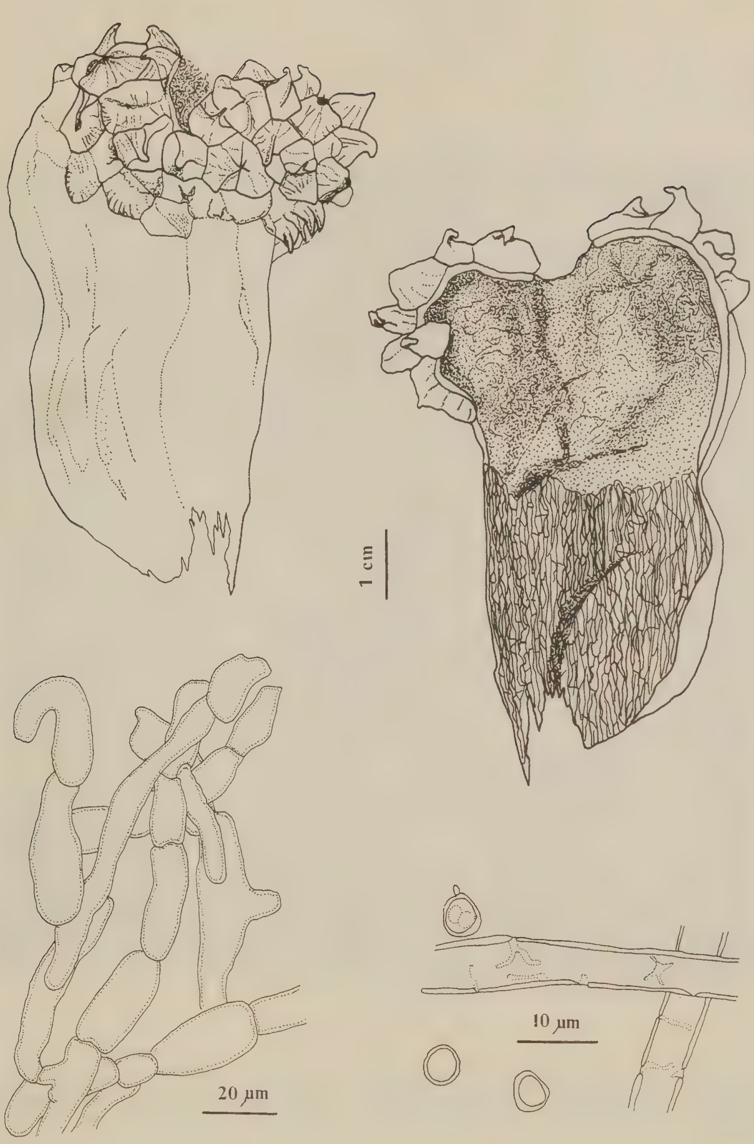

Fig. 2. *Calvatia utriformis*, BCC-MPM 1314 (a-d). a: fruit-body, b: longitudinal section of the fruit-body; c: exoperidium formed by sphaerocysts and hyphae; d: spores and capillitium hyphae.

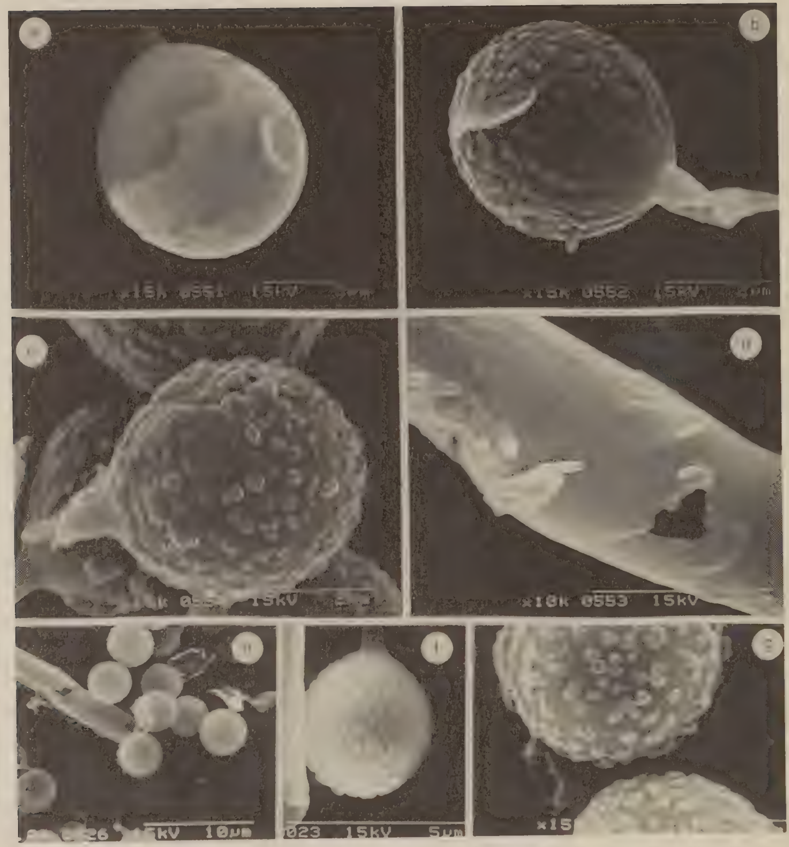
b
x15k 0552 15kV
x18k 0553 15kV
15kV 10µm
023 15kV 5µm
x15

Fig. 3. *Calvatia utriformis*, BCC-MPM 1314 (a-d). a-c: spores; d: slitlike pore. *C. utriformis* var. *gruberi*, HOLOTYPE (e-g). e: spores and capillitium hyphae showning a slitlike pore; f-g: spores.

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THE GENUS *AMANITA* (AMANITACEAE, AGARICALES) IN ZAMBIA

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Abstract

Seventeen species of *Amanita* Pers. (*Agaricales, Amanitaceae*) from Zambia are listed; fifteen are described and illustrated, and keys to the determination of species provided. Most species belong to the sections *Lepidella* (five species) and *Vaginatae* (eight species). *Amanita miomboensis* and *A. afrospinosa* are described as new.

Amanita Pers. is a cosmopolitan genus, especially well represented throughout the equatorial and south-eastern regions of Africa. The genus is moderately well documented for sub-Saharan Africa, with earlier accounts from Zaïre by Beeli (1931, 1935), which were later developed by Gilbert (1940 - 41), who made two new combinations, validated one species, created one legitimate new name and one illegitimmate name. Additional information has been published by Buyck (1994), for Burundi, and Härkönen, Saarimäki & Mwasumbi (1994), for Tanzania, whilst Pearson (1950) and Reid & Eicker (1991) offered good accounts for South Africa. Introductory accounts for south-eastern Africa may be found in Pegler & Piearce (1980), Piearce (1977) and Ryvarden, Piearce & Masuka (1994).

Piearce (1985) has suggested that fungi mentioned in the original journals of David Livingstone for 1865, during his travels around the southern border of modern Zambia, could well have represented species of *Amanita* , as well as *Lactarius* Gray and *Russula* Pers. In addition to earlier records, the present account is largely based upon material recently collected by one of the authors (DSS) from the North Luangwa National Park in the Mpika District of

Zambia, as part of the North Luangwa Conservation Project. The park, covering 4636 km^2, is situated on the west bank of the Luangwa river, a major tributary of the Zambezi river, and is bordered by the Lufila river to the north and the Munyamadzi corridor to the south. The eastern boundary of the park incorporates the Muchinga escarpment. The vegetation of the park varies from *Colophospermum mopane* (Kirk ex. Benth.) J. Léon. woodlands, and bushland thicket growing on the hot, low-lying valley floor (600 m a.s.l.) to the cool shady 'miombo' woodlands found on the slopes of the Muchinga escarpment (1200 m).

The 'miombo' woodlands are rich in fungal diversity owing to the ectomycorrhizal association, especially between species of *Amanita, Cantharellus* Juss., *Lactarius* and *Russula* and members of the tree families *Leguminosae* subfamily *Caesalpinoideae* (*Brachystegia* Benth., *Isoberlinia* Craib & Stapf and *Julbernardia* Pellegr.) and *Euphorbiaceae* (*Uapaca* Baill.). The dominant tree species include *Brachystegia spiciformis* Benth., *B. stipulata* De Willd., *B. utilis* Burtt, Davy & Hutch., *Julbernardia paniculata* (Benth.) Troupin and *Pseudolachnostylis maprouneifolia* Pax (*Euphorbiaceae*). In the escarpment riverine areas the forests are dominated by species such as *Syzgium cordatum* (Hochst.) Krauss. (*Myrtaceae*), *Craterispermum schweinfurthii* Hiern (*Rubiaceae*), *Monopetalanthus trapnellii* J. Léon (Leguminosae: *Caesalpinoideae*) and *Uapaca* species.

The following account provides descriptions and illustrations of sixteen species. Interestingly, these are almost equally divided between the Section *Vaginatae* (Fr.) Quél., which is dominant in the African equatorial regions and the Section *Lepidella* (Gilb.) Corner & Bas, which is so abundant in southern Africa. The sections *Amanita* and *Phalloideae* (Fr.) Quél., commonly found throughout the North temperate zone, are rarely encountered in south-eastern Africa, and then most often as exotics, which are probably introduced with plantation trees.

KEY TO SECTIONS OF *Amanita*

1. Spores inamyloid; pileal margin radially sulcato-striate 2
   Spores amyloid; pileal margin usually smooth, rarely sulcato-striate.......... 3
2. Stipe with a bulbous base; volva friable ....**Sect. 1. Amanita**
   Stipe lacking a bulbous base; volva saccate or friable.................................. ....**Sect. 2. Vaginatae**
3. Volva floccoso-pulverulent, friable 4
   Volva saccate; pileal margin often not appendiculate 5

4. Volval remnants adherent to white or pale pileipellis; pileal margin appendiculate; annulus floccose to fugacious; stipe distinctly bulbous at base, at times rooting .... **Sect. 3. Lepidella**
Volval remnants easily washed off; pileipellis coloured; pileal margin not ` appendiculate, annulus membranaceous, rarely fugacious; stipe subbulbous only .... **Sect. 4. Validae**
5. Pileipellis coloured; spores globose to ellipsoid; annulus membranaceous; lamellae not darkening when dry .... **Sect. 5. Phalloideae**
Pileipellis typically white or brown; spores broadly ellipsoid to bacilliform; annulus often friable; lamellae darkening when dried slowly .... **Sect. 6. Amidella**

Section **1. Amanita**

Amanita muscaria (L. : Fr.) Hooker is an exotic species which has yet to be recorded from Zambia. Its presence might be expected, however, for it was reported from Malawi by Morris (1990) as 'common in conifer plantations'.

Section **2**. **Vaginatae** *(Fr.) Quél.* in Mém. Soc. Emul. Montbéliard sér. 2, 5: 64 (1872).

KEY TO SECTION *Vaginatae*

1. Basidioma robust; pileus up to 30 cm diam., white with an olive-brown centre; stipe white and annulate; volva blackish brown, with indefinite, floccose squamules; spores 9 - 13 x 8 - 10.5 µm, subglobose to broadly ovoid .... **1. A. zambiana**
Basidioma slender; pileus rarely exceeding 12 cm diam. on expansion, yellow, orange or dark brown 2
2. Spores subglobose to short ovoid, quotient up to 1.3 3
Spores ellipsoid to cylindrical, quotient 1.5 - 1.95 5
3. Pileus grey-brown to dark brown; spores 7.5 - 9 x 6.5 - 8 µm, subglobose; lamellae, stipe and volva whitish; exannulate .... **2. A. elegans**
Pileus lemon-yellow to orange-ochre 4
4. Spores very small, 4 - 5 x 3.5 - 4.5 µm, subglobose; pileus, lamellae and stipe lemon-yellow; volva lemon-yellow, at times white, not squamose; stipe exannulate ....**3. A. aurea**

Spores large, 10 - 12.5 x 8 - 10 µm, ovoid; pileus orange-ochre; lamellae, stipe and volva pale yellow; volva covered with prominent, pyramidal squamules; stipe annulate .... **4. A. strobilaceovolvata**

5. Pileus brownish grey with pinkish grey squamules; lamellae whitish; stipe charcoal grey in median region, exannulate; spores 10 - 14 x 7 - 9 µm, ovo-ellipsoid .... **5. A. calopus**

Pileus orange, yellowish brown or reddish brown 6

6. Pileus, lamellae and stipe saffron-yellow; volva white; stipe exannulate; spores 12.5 - 16 x 6.8 - 8.5 µm, cylindrical .... **6. A. flammeola**

Pileus dark reddish brown, orange or yellowish brown; lamellae white to cream-colour; stipe annulate 7

7. Stipe white, with zones of yellowish brown squamules; spores 9 - 13 x 5.5 - 7.5 µm; clamp-connexions absent .... **7. A. mafingensis**

Stipe pale brown, with dark reddish brown squamules; spores 10 - 13 x 6.5 - 9 µm; clamp-connexions present ....**8. A. infusca**

1. Amanita zambiana *Pegler & Piearce* in Kew Bull. 35: 485, fig. 2 (1980).

Pileus 10 - 20 (-30) cm diam., at first globose to ovoid and uniformly olivaceous brown, expanding to applanate and uniformly white apart from olivaceous brown centre; surface smooth, glabrous, shiny, very viscid, not retaining any velar squamules; margin finely sulcato-striate. *Lamellae* free, remote, white, ventricose, up to 1.5 cm broad, very crowded, with lamellulae of three lengths; edge floccoso-denticulate. *Stipe* 10 - 15 x 1.5 - 2 (-4) cm, cylindrical, stout, fistulose then soon hollow; surface whitish, fibrillose, annulate and with broad, saccate volva. *Annulus* ample, pendulous, white, membranaceous, finely striate, attached to upper stipe. *Volva* 5 - 10 x 3 - 5 cm, initially blackish brown, with outer layer disrupting into large, indefinite verrucae. *Pileal context* up to 1.5 cm thick at centre, soft fleshy, white, unchanging; consisting of thin-walled hyphae, 3 - 5 µm diam., with fusoid to ellipsoid acrophysalides up to 35 µm diam., with clamp-connexions; *odour and taste* strong. *Spores* 9 - 13 x 8 - 10.5 (11 ± 0.8 x 8.8 ± 0.5) µm; Q = 1.23, subglobose to broadly ovoid, hyaline, inamyloid, thin-walled, usually with single guttule. *Basidia* 40 - 60 x 11 - 12.5 µm, clavato-pedicellate, lacking clamp-connexions, bearing four sterigmata. *Lamella-edge* sterile, coated with velar remnants, 25 - 36 x 17 - 20, globose to pyriform, hyaline, thin-walled. *Hymenophoral trama* distinctly bilateral, hyaline, with inflated hyphae, up to 25 µm diam. *Subhymenial layer* pseudoparenchymatous, 14 - 19 µm wide.

Pileipellis strongly gelatinized epicutis, up to 250 μm thick, of radially repent hyphae, 1.5 - 2.5 μm diam. Fig. 1 E - G.

SPECIMENS EXAMINED. ZAMBIA, Copperbelt Prov., Kitwe, January 1966, *Ivory* FP176/66 (KM29729, holotype); January 1975, *Piearce* 21, K(M)29731; purchased between Ndola and Kitwe, 22 Dec. 1978, *Piearce* FP602/1, K(M)29734; Mpika Distr., North Luangwa Nat. Park, 13 Dec. 1994, *Shah-Smith* 75, K(M)29009.

This is one of the largest species in Zambia, generally associated with *Brachystegia* and often found at the side of gravel roads, occurring in small groups. This very common and widespread species is known locally under the names of '*tente*', '*ndelema*' and the '*Christmas Mushroom'*, being most abundant around December and early January. It is a good, edible species according to Parent & Thoen (1977), Pegler & Piearce (1980) and Buyck (1994), widely sold in markets where it is a dominant species on the stalls. According to Buyck (1994), the fungus described by Beeli as *Amanita loosii* from Zaïre may represent an earlier name for the species. It is also known from Malawi and southern Tanzania. The species is closely allied to the south-east Asian species, *A. hemibapha* (Berk. & Broome) Sacc. ssp. *similis* (Boed.) Corner & Bas and *A. princeps* Corner & Bas.

Good colour illustrations have been provided by Buyck (1994: figs. 7, 54 - 55 and cover); Härkönen, Saarimäki & Mwasumbi (1995: figs. 54 - 55 and cover); Piearce (1977:13), and Ryvarden, Piearce & Masula (1994).

2. Amanita elegans *Beeli* in Bull. Soc.Roy. Bot. Belgique 63: 105, pl.8/5 (1931).

Ariella elegans (Beeli) E. J. Gilbert in Bres., Iconogr. Mycol. 27, suppl. 1 (1): 70 (1940).

Pileus 3 - 6.5 cm diam., conical becoming applanato-convex; surface dark grey, greyish brown to fuliginous brown, at times yellowish brown to yellowish pink, darker at the centre, viscid; margin thin, whitish, plicato-striate. *Lamellae* free, white, up to 7 mm wide, with truncated lamellulae of two lengths. *Stipe* 6 -10 cm x 0.4 - 1.3 cm, cylindrical, bulbous towards base, fistulose; surface white, with faint, concentric rings of soft squamules, fibrous. *Annulus* thin and ephemeral, attached to middle of stipe. *Volva* saccate, up to 3.5 cm high, membranaceous, white or fuliginous, subterranean. *Pileal context* thin, about 4 - 5 mm at disk, firm, white, consisting of thin-walled hyphae, 4 - 7 μm diam., with fusoid to broadly ellipoid acrophysalides to 40 μm diam.,

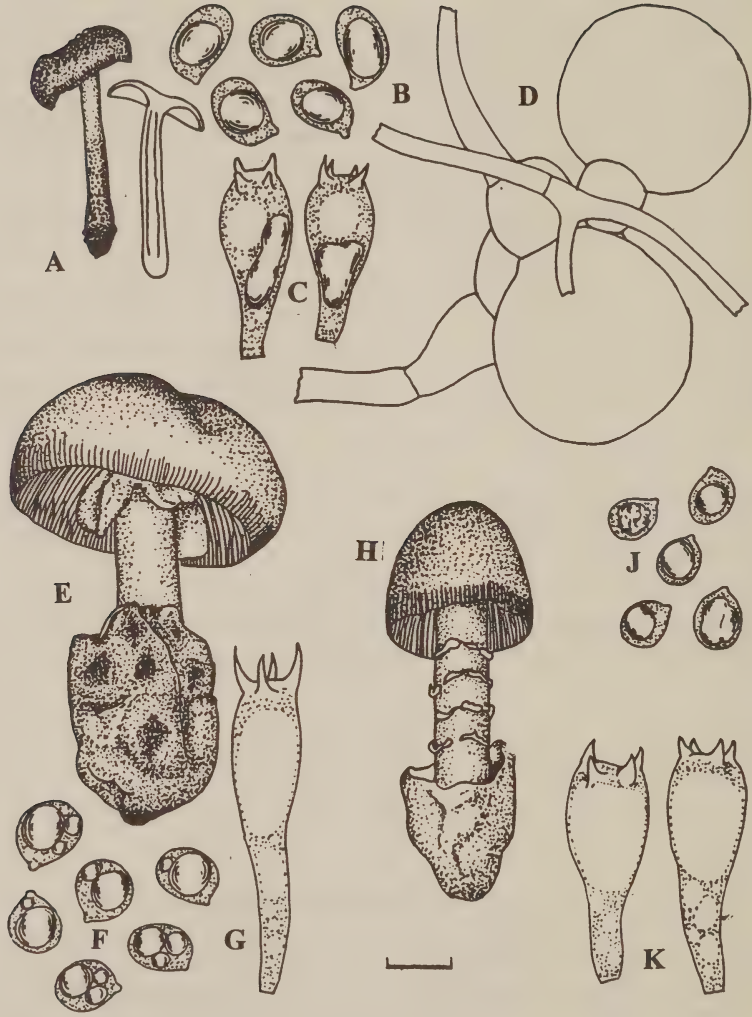

Fig. 1. **A - D** *Amanita calopus*. **A** habit and section (*Shah-Smith* 102); **B** spores, **C** basidia; **D** velar elements. **E - G** *A. zambiana*. **E** habit and section (*Piearce* FP602/1); **F** spores, **G** basidium. **H - K** *A. elegans*. **H** habit (*Shah-Smith* 121); **J** spores, **K** basidia. Bar-line: 1 cm for basidioma; 20 μm for micro-structures

lacking clamp-connexions; *taste* acrid. *Spore deposit* white. *Spores* 7.5 - 9 x 6.5 - 8 (8.5 ± 0.55 x 7.3 ± 0.38) µm, Q = 1.17, subglobose to short ovoid, hyaline, inamyloid, thin-walled. *Basidia* 35 - 45 x 13 - 15 µm, broadly clavate, lacking clamp-connexions, tetrasporic. *Lamella-edge* sterile, persistently coated with velar remnants. *Hymenophoral trama* bilateral, hyaline, with diverging hyphae, 2 - 4 µm diam., many inflated to 45 µm diam., lacking clamp-connexions. *Subhymenial layer* 15 - 25 µm wide, pseudoparenchymatous. *Pileipellis* agglutinated cutis, of woven, repent hyphae, 3 - 6.5 µm diam., thin-walled, either hyaline or with brown vacuolar contents. *Volva elements* comprising non-inflated, parallel hyphae, 4 - 7 µm diam., lacking both inflated elements and clamp-connexions. Fig. 1 H - K

SPECIMENS EXAMINED. ZAMBIA, Copperbelt Province, Kitwe, 7 Dec. 1978, *Piearce* FP593/8, K(M)29783; Mpika Distr., North Luangwa Nat. Park, 12 Jan. 1995. *Shah-Smith* 121, K(M)28999; *Shah-Smith* 125, K(M)28996. MALAWI, Zomba, Makwawa, 8 Dec. 1979, *Morris* 11, K(M)29781; 4 Mar. 1980, *Morris* 148, K(M)29782.

The species was originally described from Zaire (Beeli, 1931), whilst Beeli (1935: pl.1/3) and Gilbert (1941: 249, pl.17) provided a coloured illustration. Other collections have been received from Malawi, where it is commonly found in open *Brachystegia* woodland. There is a superficial resemblance to the Paddy Straw Mushroom, *Volvariella volvacea* (Bull.: Fr.) Sing.

3. Amanita aurea *(Beeli) E. J. Gilbert* in Bres., Iconograph. Mycol. 27, suppl. 1(2): 205 (1941).
Amanitopsis aurea Beeli in Bull. Soc. Roy. Bot. Belgique 63: 108 (1931).

Pileus 5 - 8 cm diam., campanulate expanding to applanate, umbonate; surface lemon-yellow to golden yellow, slightly darker at centre, smooth, shiny; margin plicato-striate half-way to centre, non-appendiculate. *Lamellae* free, pale yellowish, 5 - 8 mm wide, moderately crowded, with truncate lamellulae of two lengths. *Stipe* 6 - 10 x 0.5 - 1.0 cm, expanding to 2.0 cm at base, otherwise cylindrical, soon hollow; surface concolorous with pileus, smooth, fibrillose silky. *Annulus* present but ephemeral and often absent. *Volva* saccate, free from stipe, membranous fleshy, white to lemon-yellow, generally not splitting into lobes. *Pileal context* very thin, 1 - 2 mm thick at disk, pale sulphur-yellow, consisting of thin-walled hyphae, 3 - 5 µm diam., with fusoid acrophysalides to 28 µm diam.; *stipe context* sulphur-yellow except for white base, reddening slightly on exposure; *taste* acrid. *Spore* *deposit* white. *Spores* 4 - 5 x 3.5 - 4.5 (4.7 ± 0.32 x 3.8 ± 0.37) µm, Q = 1.12, subglobose, hyaline, inamyloid, with slightly thickened wall, usually containing large, refractive guttule. *Basidia* 28 - 30 x 6 - 8 µm, cylindrico-clavate, with clamp-connexions, tetrasporic. *Lamella-edge* sterile, persistently coated with velar remnants. *Hymenophoral trama* indistinctly bilateral, hyaline, with narrow mediostratum of weakly inflated hyphae, and broad lateral strata of much inflated hyphae, 3 - 20 µm. *Subhymenial layer* 10 - 15 µm wide, pseudoparenchymatous. *Pileipellis* repent cutis, 30 - 40 µm thick, of thin-walled, radially parallel hyphae, 3 - 9 µm diam., overlain by thin ixocutis of narrow, branching hyphae, 1 - 2.5 µm diam., with gelatinized walls. Fig. 2 A - D

SPECIMENS EXAMINED. ZAMBIA, Copperbelt Province, Kitwe, Riverside Laboratories, February 1973, *Ivory* FP6/2, KM29780. TANZANIA, Southern Highlands province, Iringa Distr., 1340m alt., 15 Dec. 1972, *Bjørnstad* 2115, K(M)29778. UGANDA, Buganda province, Mengo Distr., Entebbe, Zika Forest, 12 June, *Pegler* U1439, K(M)29776; *Pegler* U1440, K(M)29777.

The remarkably small spores are distinctive amongst species of *Amanita*. It is found either solitary or in small groups in miombo woodlands. It was originally described from Zaire (Beeli, 1931) and also reported from Uganda (Pegler, 1977: 298). Colour illustrations have been provided by Beeli (1935: pl. 4/2), Gilbert (1941: 205, pl. 2) and Ryvarden, Piearce & Masuka (1994).

4. Amanita strobilaceovolvata *Beeli* in Fl. Iconogr. Champ. Congo 1: 14 (1935).
Amanitopsis fibrillosa Beeli, *loc. cit.* 22 (as '*fibrilosa*').
Amanitopsis strobilaceovolvata (Beeli) E. J. Gilbert in Bres., Iconogr. Mycol. 27, suppl. 1 (1): 75 (1940).

Pileus 5 - 12 cm diam., conico-campanulate becoming convex with prominent umbo; surface orange-ochre with margin paling to yellowish cream, viscid when moist otherwise dry, smooth; margin broadly plicato-striate. *Lamellae* free, very pale lemon-yellow, darkening with age, narrow (4 - 6 mm wide), moderately crowded, with lamellulae of two lengths. *Stipe* 9 - 11 x 0.5 - 1.0 cm, cylindrical, solid soon hollow; surface initially yellow becoming whitish, viscid, floccose, glabrescent. *Annulus* membranaceous, pendent, fragile, white with yellow tints at edge, attached towards stipe apex. *Volva* saccate, 2 - 3 x 1.5 - 2 cm, thick fleshy, initially pale creamy brown with yellowish tints becoming off-white, strobiloid with numerous, overlapping pyramidal squamules. *Pileal context* very thin, firm, white, yellow below pileipellis, consisting of inflated, thin-walled hyphae, 3 - 5µm diam., with fusoid to ellipsoid acrophysalides to 28 µm diam., lacking clamp-connexions; *odour* nil; *taste* slightly bitter. *Spore deposit* white. *Spores* 10 - 12.5 x 8 - 10 (12 ± 0.8 x 9.2 ± 0.6) µm, Q = 1.30, subglobose to broadly ellipsoid, hyaline, inamyloid, thin-walled. *Basidia* 30 - 38 x 11 - 13 µm, broadly clavate, tetrasterigmate. *Lamella-edge* probably sterile. *Hymenophoral trama* bilateral, hyaline, with diverging, thin-walled hyphae, 16 - 20 µm wide. *Subhymenial layer* pseudoparenchymatous, 15 - 20 µm wide. *Pileipellis* an ixocutis, 150 - 250 µm thick, of narrow, hyaline, interwoven hyphae, 2 - 3.5 µm diam., embedded in hyaline, gelatinous matrix. Fig. 2 D - F.

SPECIMENS EXAMINED. ZAMBIA, Mpika Distr., North Luangwa Nat. Park, 11 Jan. 1995, *Shah-Smith* 111, K(M)29006; 18 Jan. 1995, *Shah-Smith* 129, K(M)29007; *Shah-Smith* 154, K(M)29008; *Shah-Smith* 193, K(M)29003; Mousa, 8 Dec. 1978, *Rose* 7818, K(M)29800.

The strobiloid appearance of the fleshy volva is a distinctive feature of this species, along with the pileus which remains strongly convex and bears a conspicuous umbo. A coloured illustration is provided by Beeli (1935: pl. 1/4 and pl. 4/1 as *A. fibrillosa*) and Gilbert (1941: 225, pl. 8). Although Beeli (1935) described the spores to be 6 µm diam. and globose, the spores drawn and illustrated by Gilbert (1941) from the type collection are nearer to those described above for the Zambian material. According to Gilbert, the type collection of *Amanitopsis fibrillosa* is based upon an old collection of *A. strobilaceovolvata.*

5. Amanita calopus *(Beeli) E. J. Gilbert* in Bres., Iconograph. Mycol. 27, suppl. 1(2) : 228 (1941).
Amanitopsis calopus Beeli in Bull. Soc. Roy. Bot. Belgique 63: 108 (1931).

Pileus 3.5 - 5.5 cm diam., fragile, subglobose, expanding to applanate to slightly depressed; surface pale brownish grey, smooth and viscid, overlain with scattered, pinkish grey, lanose-floccose patches of universal veil, varying from pyramidal to flattened, glabrescent; margin plicato-striate. *Lamellae* free, attenuate, white to very pale grey, thin, up to 5 mm wide, moderately crowded, with lamellulae of two lengths; edge denticulate. *Stipe* 5 - 5.5 (-11) x 0.3 - 0.5 (- 0.9) cm, cylindrical, slightly expanding towards apex and with small but distinct marginate base, fistulose; surface white, covered with minute, pale grey squamules, darkening to charcoal-grey towards centre of stipe. *Annulus* absent. *Volva* present but reduced to small, pyramidal squamules which form raised rim around stipe basal bulb, grey to brown, additional scattered remnants on lower stipe. *Pileal context* very thin, white, unchanging; consisting of thin-walled, hyaline hyphae, 3 - 7 µm diam., with ellipso-fusoid to piriform acrophysalides up to 40 µm diam.; *odour* not distinctive; *taste* bitter. *Spores* 10 - 14 x 7 - 9 (11.7 ± 1.4 x 7.7 ± 0.8) µm, Q = 1.50, broadly ovoid to ellipsoid, hyaline, inamyloid, thin-walled, containing large refractive guttule. *Basidia* 27 - 35 x 11 - 12 µm, broadly clavate, clamp-connexions not seen, tetrasporic. *Lamella-edge* sterile, with scattered velar elements.. *Hymenophoral trama* bilateral, with much inflated hyphae, 3 - 7 µm diam., inflating to 40 µm diam. *Subhymenial layer* 25 - 45 µm wide, pseudoparenchymatous. *Pileipellis* a thin ixocutis of radially parallel, thin-walled hyphae, 3 - 7 µm diam. *Velar remnants* comprising abundant sphaerocytes, 15 - 75 µm diam., borne on narrow branching, hyaline hyphae, 2 - 8 µm diam., lacking clamp-connexions. Fig. 1 A - D.

SPECIMENS EXAMINED. ZAMBIA, Mpika Distr., North Luangwa Nat. Park, 10 Jan. 1995, *Shah-Smith* 102, K(M)30017. MALAWI, Thyolo Distr., Nachingwea Estate, 14 Jan. 1974, Williamson 773, K(M)30018.

A solitary species, found in open, ‘miombo’ grassland. It was compared to *A. rubescens* Pers. by Buyck (1994), and superficially resembles the South African form of *A. excelsa* (Fr.) Bertillon, as described by Reid & Eicker (1991), albeit with a more slender habit. The spores, however, are inamyloid and very much larger than those found in either species, whilst the pileal margin is striate, no annulus is formed, and a volva is partially developed. The white context does not redden on exposure. The volva of the Zambian collection is reduced to flattened, grey-brown patches forming one or more indefinite rings around the bulbous stipe base, whilst in the Malawi collection, the velar squamules are pyramidal, resembling those of *A. strobilaceovolvata* Beeli, although overall the volva is neither membranaceous nor truly saccate. Beeli (1931) emphasized an ‘orange’ colouration of the volval remnants but this is found in neither of the collections cited below. At times, the elements of the veil have a reddish brown pigmented wall, otherwise the orange colour of the fungus from Zaïre is possibly the result of staining from the lateritic soil, for the stipe base is normally subterranean and easily overlooked.

The species has been illustrated by Beeli (1931: pl. 9, fig. 14; 1935: pl. 4, fig. 5) and by Gilbert (1941: pl. 9).

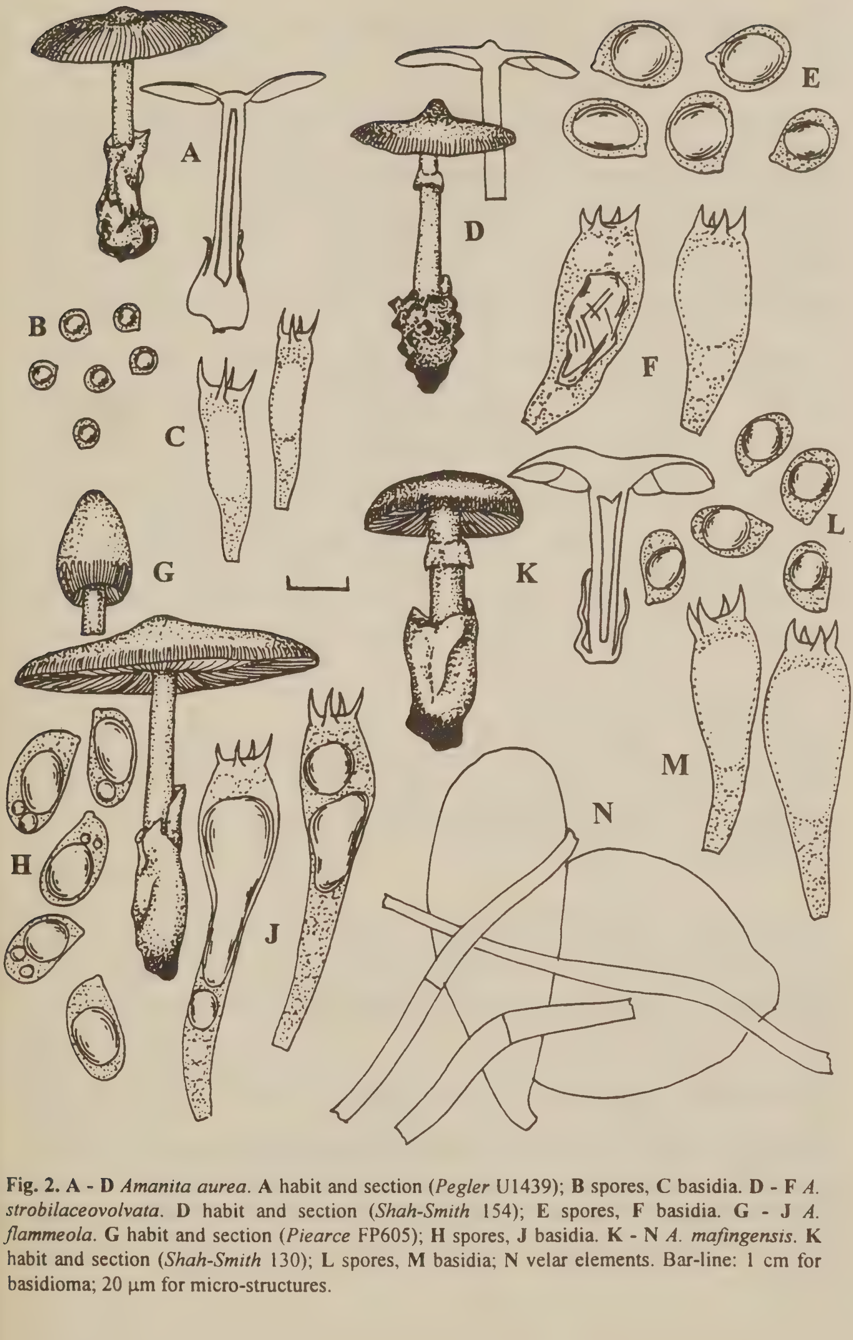

Fig. 2. **A - D** *Amanita aurea*. **A** habit and section (*Pegler* U1439); **B** spores, **C** basidia. **D - F** *A. strobilaceovolvata*. **D** habit and section (*Shah-Smith* 154); **E** spores, **F** basidia. **G - J** *A. flammeola*. **G** habit and section (*Piearce* FP605); **H** spores, **J** basidia. **K - N** *A. mafingensis*. **K** habit and section (*Shah-Smith* 130); **L** spores, **M** basidia; **N** velar elements. Bar-line: 1 cm for basidioma; 20 μm for micro-structures.

6. Amanita flammeola *Pegler & Piearce* in Kew Bull. 35: 482, fig. 3 (1980).

Pileus 6 - 9 cm diam., initially conical then expanding to applanate with central umbo; surface saffron-yellow to straw-yellow at the margin becoming paler at maturity. *Lamellae* free, saffron-yellow or paler, ventricose, crowded, with truncate lamellulae of three lengths; edge floccoso-denticulate. *Stipe* 6 - 15 x 0.5 - 2 cm, elongate cylindrical, solid; surface concolorous with pileus, pruinose, exannulate. *Volva* cylindrico-saccate, up to 6 cm tall, membranaceous, white. *Pileal context* fairly thick, firm, white, consisting of loosely woven, thin-walled hyphae, 2 - 7 μm diam., with ellipsoid acrophysalides up to 25 μm diam., lacking clamp-connexions. *Spore deposit* very pale salmon-pink.. *Spores* 12.5 - 16.5 x 6.8 - 8.5 (14.5 ± 1.0 x 7.4 ± 0.4) μm, Q = 1.95, elongate ellipsoid to cylindrical, hyaline, inamyloid, thin-walled, with refractive guttulate contents. *Basidia* 50 - 57 x 12 - 13 μm, elongate clavate, lacking clamp-connexions, bearing four sterigmata. *Lamella-edge* sterile, with crowded, subglobose to pyriform velar remnants. *Hymenophoral trama* bilateral, hyaline, with diverging, thin-walled hyphae, 18 - 25 μm wide. *Subhymenial layer* pseudoparenchymatous, 18 - 25 μm wide. *Pileipellis* ixocutis, 150 - 250 μm thick, of narrow, hyaline, interwoven hyphae, 1.7 - 3.5 μm diam., embedded in hyaline, gelatinous matrix. Fig. 2 G - J.

SPECIMENS EXAMINED. ZAMBIA, Copperbelt Province, purchased by roadside betwen Kitwe and Ndola, 22 Dec. 1978, *Piearce* FP602/2, K(M)29736; Masaka Nat. For., in indigenous woodland, 28 Dec. 1978, *Muthali* in *Piearce* FP605, K(M)29730, holotype; Misaka Botanical Res., 21 Dec. 1982, *Piearce* 731/1, KM29738.

These bright yellow mushrooms are normally found on the soil in miombo woodland, with the tall, narrow, white volva entirely buried below the soil surface. The species is known locally under name of '*musholomwa*', and although never available in abundance it is regarded as an edible species.

7. Amanita mafingensis *Härk. & Saarimäki* in Karstenia 34: 53 (1994).

Pileus 3 - 3.5 (-8) cm diam., broadly convex, finally depressed; surface dark reddish brown (copper-brown) to orange, becoming dark brown at inner ends of marginal striations, smooth, glutinous and shiny; margin plicato-striate. *Lamellae* free, white to cream-colour, yellowing, 1.0 - 1.5 cm wide, crowded, with truncated lamellulae of two lengths; edge brown. *Stipe* 5.5 - 7 x 0.7 - 1.0 cm, cylindrical, hollow; surface white, annulate and volvate, finely striate above annulus, coarsely scabrous with concentric zones of floccose, yellow, yellowish brown to yellowish olive squamules below the annulus. *Annulus* attached to upper stipe, membranous, pale yellow, more or less persistent, striate. *Volva* saccate, white or greyish, membranaceous-fleshy, extending half-way up stipe, subterranean. *Pileal context* up to 10 mm thick, white, orange-brown below pileipellis, unchanging,consisting of very thin-walled, hyaline hyphae, 3 - 8 µm diam., with fusoid to ellipsoid acrophysalides up to 35 µm diam., *odour* faintly soapy; *taste* mild. *Spore deposit* white. *Spores* 9 - 13 x 5.5 - 7.5 (9.9 ± 0.75 x 6.4 ± 0.59) µm, Q = 1.54, ellipsoid, hyaline, inamyloid, thin-walled, smooth, containing large refractive guttule. *Basidia* 35 - 42 x 10 - 13 µm, clavate, clamp-connexions not seen, tetrasporic, with occasional clamp-connexions. *Lamella-edge* sterile, but with numerous globose, ellipsoid or pyriform elements, 22 - 30 µm diam., of partial veil remaining attached and often in fasciculate tufts. *Hymenophoral trama* bilateral, hyaline, of diverging hyphae, 2 - 8 µm diam., inflating to 20 µm diam. *Subhymenial layer* 15 - 20 µm wide, pseudoparenchymatous, with large elements. *Pileipellis* repent ixocutis of narrow, agglutinated hyphae, 1.5 - 6 µm diam., with slightly thickened, brown wall, together with scattered vascular hyphae, up to 17 µm diam. *Volva elements* gelatinized, composed mainly of narrow, interwoven hyphae, 1.5 - 5 µm diam., but with few, scattered, globose or inflated clavate elements, 18 - 45 µm diam. Fig. 2 K - N.

SPECIMENS EXAMINED. ZAMBIA, Luapala Province, Monsa, Dec. 1978, Rose 7810, K(M)30053; Mpika Distr., North Luangwa Nat. Park, Mwaleshi Camp, 15 Jan. 1995, *Shah-Smith* 130, K(M)30054. MALAWI, Mzuzu, Mar. 1973, Pawk & Williamson 637, K(M)30052; Malosa, 15 Feb. 1980, Morris 109, K(M)30051.

A very distinctive species, with the reddish brown pileus contrasting with the pale yellow of the lamellae, annulus and stipe, and the large, white volva. It grows in scattered groups in open grassland, and probably is mycorrhizal with miombo trees. According to Härkönen, Saarimäki, & Mwasumbi (1994), who described it from Tanzania, this is one of the most variable species including forms with grey veils, and with white volva and yellow annulus. The species has been compared with the widespread and familiar, east Asiatic species, *A. hemibapha* (Berk. & Broome) Sacc., which has smaller, subglobose spores. Colour photographs of Tanzanian material are provided by Härkönen, Saarimäki, & Mwasumbi (1994: fig. 6; 1995: fig. 53).

8. Amanita infusca E. J. Gilbert ex Singer in Lilloa 22: 385 (1951); E. J. Gilbert in Bres. , Iconogr. Mycol. 27, suppl. 1 (2): 231 (1941).
Amanita umbrina Beeli in Bull. Soc. Bot. Belg. 63: 104 (1931), non *A. umbrina* Pers.

Pileus 7 - 14 cm diam., fleshy, broadly convex to applanate; surface dark reddish brown, sometimes paling to yellowish brown at the disk, darker at margin, viscid; margin deep plicato-striate, finally upturned. *Lamellae* free, white, up to 10 mm wide, crowded, with truncate lamellulae of two lengths; edge white or brown. *Stipe* 8 - 12.5 x 1 - 2 cm, tall, cylindrical or tapering above, fistulose; surface pale brown bearing very pale brown squamules above annulus, and reddish brown to dark reddish brown squamules below annulus, annulate and volvate. *Annulus* present towards stipe apex, membranaceous, pale to reddish brown, persistent. *Volva* saccate, firm-fleshy, white with brownish grey margin, subterranean. *Pileal context* firm, white to pale brown, discolouring pinkish, consisting of loosely woven, thin-walled hyphae, 3 - 7 μm diam., with ellipsoid acrophysalides up to 26 μm diam., with prominent clamp-connexions; *odour* faint. *Spore deposit* cream-colour. *Spores* 10 - 13 x 6.5 - 9 (11.2 ± 0.8 X 7.4 ± 0.8) μm, Q = 1.50, broadly ellipsoid, hyaline, inamyloid, thin-walled, with large, refractive guttule. *Basidia* 45 - 55 x 10 - 13 μm, elongate-clavate, with clamp-connexions, tetrasporic. *Lamella-edge* sterile, with fascicles of globose to ellipsoid velar elements. *Hymenophoral trama* bilateral, hyaline, with diverging hyphae, 3 - 5 μm diam., inflating to 20 μm diam., with clamp-connexions. *Subhymenial layer* 17 - 26 μm wide, pseudoparenchymatous. *Pileipellis* an ixocutis of firmly agglutinated, narrow, interwoven hyphae, 1.5 - 4 μm diam., with thin brown wall. *Volva elements* most loosely woven, hyaline hyphae, 2 - 9 μm diam., but intermixed with scattered, globose to clavate elements, 15 - 45 μm diam. Fig. 3 A - D.

SPECIMENS EXAMINED. ZAMBIA, Mpika Distr., North Luangwa Nat. Park, 18 Jan. 1995, *Shah-Smith* 137, K(M)29011.

This species was described from Zaire and was figured by Beeli (1931: pl. 7/4; 1935: pl. 1/7) and by Gilbert (1941: pl. 10). The tall basidiomata are readily recognized by the dark brown colouration of the pileus, stipe, and annulus, and the squamules on the stipe. Microscopically it closely resembles *A. mafingensis* although the spores are larger and there are abundant clamp-connexions on all the hyphae. Further, it lacks the yellow tints of the lamellae, stipe and annulus of that species.

Section **3. Lepidella** *(Gilb.) Veselý* emend. *Corner & Bas* in Persoonia 2: 244 (1962).

KEY TO SECTION *Lepidella*

1. Spores subglobose to ovoid, quotients ranging from 1.1 - 1.34 2
Spores oblong-ellipsoid, quotients 1.45 - 1.80 3
2. Basidioma white bruising lemon-yellow; pileus initially covered with large, soft-floccose velar squamules but soon glabrescent and smooth; odour mild, sweet; spores 8 - 10.5 x 6.5 - 8.5 µm, subglobose ..... **9. A. praeclara**
Basidioma white to cream-buff, not bruising; pileus with concentric zones of glutinous velar squamules. with dark brown apices, concentrated at centre; odour srong and unpleasant; spores 8.5 - 10.5 x 5.5 - 8 µm, broadly ovoid... **10. A. foetidissima**
3. Pileus initially densely coated with large, overlapping, truncate-pyramidal, white squamules, glabrescent; volval remnants forming concentric zones of pyramidal squamules on stipe base; spores relatively small, 8 - 9 x 4 - 5 µm ....**11. A. afrospinosa**
Pileus bearing grey, pink to dark red, small velar squamules; spores broader 4
4. Pileus with soft-floccose, pinkish grey squamules on white ground; stipe white with pinkish volval remnants over stipe base; spores 8.5 - 10 x 5.5 - 6.5 µm; clamp-connexions absent .... **12. A. miomboensis**
Pileus with small, erect, fibrillose, pink to dark red squamules on cream-coloured ground; stipe with several zones of dark reddish, velar squamules over stipe base; spores 7 - 12 x 4 - 7.5 µm; clamp-connexions present .... **13. A. pleropus**

9. Amanita praeclara *(Pearson) Bas* in Persoonia 5: 380 (1969).
Lepiota praeclara Pearson in Trans. Br. Mycol. Soc. 33: 288 (1950).

Pileus 5 - 12 (-16) cm diam., subglobose to convex, finally slightly depressed, fleshy; surface white, silky-fibrillose, smooth, bruising pale lemon-yellow, at first covered with dense, shaggy, lanose, initially pyramidal, velar squamules, glabrescent and leaving stippled, floccose surface; margin inrolled, strongly appendiculate with velar remnants. *Lamellae* free, white to cream-colour, staining lemon-yellow, 1 - 2 cm wide, subdistant, but with truncate lamellulae of two lengths. *Stipe* 6 - 12 cm x 1.5 - 2.5 cm, cylindrical with submarginate bulbous base (- 4 cm diam.) and often tapering, solid to fistulose; surface white discolouring sulphur-yellow below annulus, initially coated with shaggy-lanose, viscid velar squamules, especially concentrated under annulus. *Annulus* membranaceous to cortinoid, ephemeral, white, wide, pendulous with fimbriate margin. *Pileal context* thick, white discolouring lemon- to sulphur-yellow in patches, exuding clear yellow fluid when cut; consisting of thin-walled hyphae, 3 - 10 m diam., with fusoid to ellipsoid acrophysalides up to 50 µm diam., without clamp-connexions; *odour* faint, sweet; *taste* mild with unpleasant aftertaste. *Spore deposit* pure white. *Spores* 8 - 10.5 x 6.5 - 8.5 (8.8 ± 0.7 x 7.5 ± 0.6) µm, Q = 1.18, subglobose, hyaline, amyloid, thin-walled, with granular contents. *Basidia* 45 - 55 x 9 - 12 µm, cylindrico-clavate, lacking clamp-connexions, tetrasporic. *Lamella-edge* probably sterile, covereed with velar remnants. *Hymenophoral trama* bilateral. *Subhymenial layer* 25 - 30 µm wide, pseudoparenchymatous. *Pileipellis* thin, non-gelatinized, repent cutis of radial hyphae, 4 - 14 µm diam. *Velar squamules* comprising loose, catenate chains of ellipsoid to fusoid, rarely subglobose elements, 35 - 130 x 10 - 30 µm, hyaline and thin-walled. Fig. 3 E - H.

SPECIMENS EXAMINED. ZAMBIA, Mpika Distr., North Luangwa Nat. Park, 11 Jan. 1995, *Shah-Smith* 115, K(M)29012; 25 Jan. 1995, *Shah-Smith* 166, K(M)30001; 26 Jan. 1995, *Shah-Smith* 177, K(M)29010. REPUBLIC OF SOUTH AFRICA, Cape Prov., Simonstown, 22 Apr. 1948, *Pearson* 10, K(M)29901, holotype, K(M)26265, isotype; Somerset East, 1878, *MacOwan* 1011, K(M)29903. TANZANIA, Eastern Prov., Uzaramo Distr., 8 Apr. 1974, *Gardiner* 114, K(M)29904. MALAWI, Zomba Distr., 27 Dec. 1973, *Williamson* 713, K(M)29905; 9 Dec. 1973, *Williamson* 648a, K(M)29906; 2 Jan. 1974, *Williamson* 740, K(M)29907.

A good illustration of this flavescent species, originally described from South Africa, was published by Pearson (1950: pl. 14); it was further illustrated by Bas (1969: figs. 81 - 83). Microscopically, it is distinguished by the subglobose spores, and the lack of clamp-connexions.

10. Amanita foetidissima *Reid & Eicker* in Mycol. Res. 95: 83 (1991).

Pileus 5.5 - 9.5 (- 13) cm diam., fleshy, initially conico-convex then convex and finally applanate to slightly depressed; surface viscid, pearly white to pale cream-buff, smooth or fissured when dry, covered with more or less concentric zones of glutinous, soft-floccose, velar squamules, with pale brown to dark brown apices, concentrated at disk, pyramidal, sparse, arachnoid and glabrescent at margin; margin incurved, wavy, appendiculate and shaggy.

Lamellae free, off-white to pale cream, sometimes with pale pinkish tinge, up to 12 mm wide, crowded, with truncate lamellulae of two lengths; edge entire. *Stipe* 6 - 9 (-13) x 0.7 - 2 cm, cylindrical although slightly enlarged at apex with pronounced, subterranean, bulbous base (2.5 - 4 cm diam.), solid; surface white, unchanging, covered with floccose, white squamules which become larger above, especially under annulus; squamules collapse when wet. *Annulus* membranous but fugacious, covered with pale yellowish, floccose squamules on underside. *Universal veil* not volvate. *Pileal context* up to 10 mm thick, firm, white, unchanging; consisting of thin-walled hyphae, 2 - 5 μm diam., with ellipsoid acrophysalides up to 26 μm diam.; clamp-connexions small and inconspicuous; *odour* strong and unpleasant. *Spore deposit* white. *Spores* 8.5 - 10.5 x 5.5 - 8 (9.4 ± 0.6 x 7 ± 0.6) μm, Q = 1.34, subglobose to broadly ovoid, hyaline, strongly amyloid, thin-walled, with large refractive guttule. *Basidia* 40 - 45 x 10 - 12 μm, clavate, with clamp-connexions, tetrasporic. *Lamella-edge* sterile, with numerous, detersile velar elements but lacking cheilocystidia. *Hymenophoral trama* bilateral, hyaline, with diverging hyphae, 2 - 5 μm, inflating to 26 μm. *Subhymenial layer* very broad, 35 - 50 μm, pseudoparenchymatous. *Pileipellis* repent cutis of subagglutinated, thin-walled, narrow, radially parallel hyphae, 4 - 9 μm diam. *Velar squamules* formed by indefinite, loose and detersile, chains of large, globose, doliiform to short fusoid elements, 27 - 170 x 17 - 60 μm, hyaline, thin-walled, with small clamp-connexions, with some encrusting pigment. Fig. 4 A - D.

SPECIMENS EXAMINED. ZAMBIA, Mpika Distr., North Luangwa Nat. Park, 13 Dec. 1994, *Shah-Smith* 49, K(M)29183; 2 Jan. 1995, *Shah-Smith,* 79, K(M)30000. REPUBLIC OF SOUTH AFRICA, Transvaal, Pretoria, 15 Feb. 1989, Eicker, K(M)15595, holotype; University of Pretoria campus, 15 Feb. 1989, *Veldis & Greunig*, K(M)15596.

Good colour photographs were provided by Westhuizen & Eicker (1994), who emphasise that heavy rains can remove the velar squamules, making recognition difficult. Half-tone photographs were provided by Reid & Eicker (1991: figs. 45 - 47). The most striking characters in the field of the large basidiomata are the strong, sickly-sweet odour and the sticky squamules which adhere when handled. The basidomata are to be found grouped in grassy areas, where the species may be confused with either *A. roseolescens* (Pearson) Bas which has a paler pileus with pinkish tinges, or *A. praeclara* (Pearson) Bas which stains yellow on bruising.

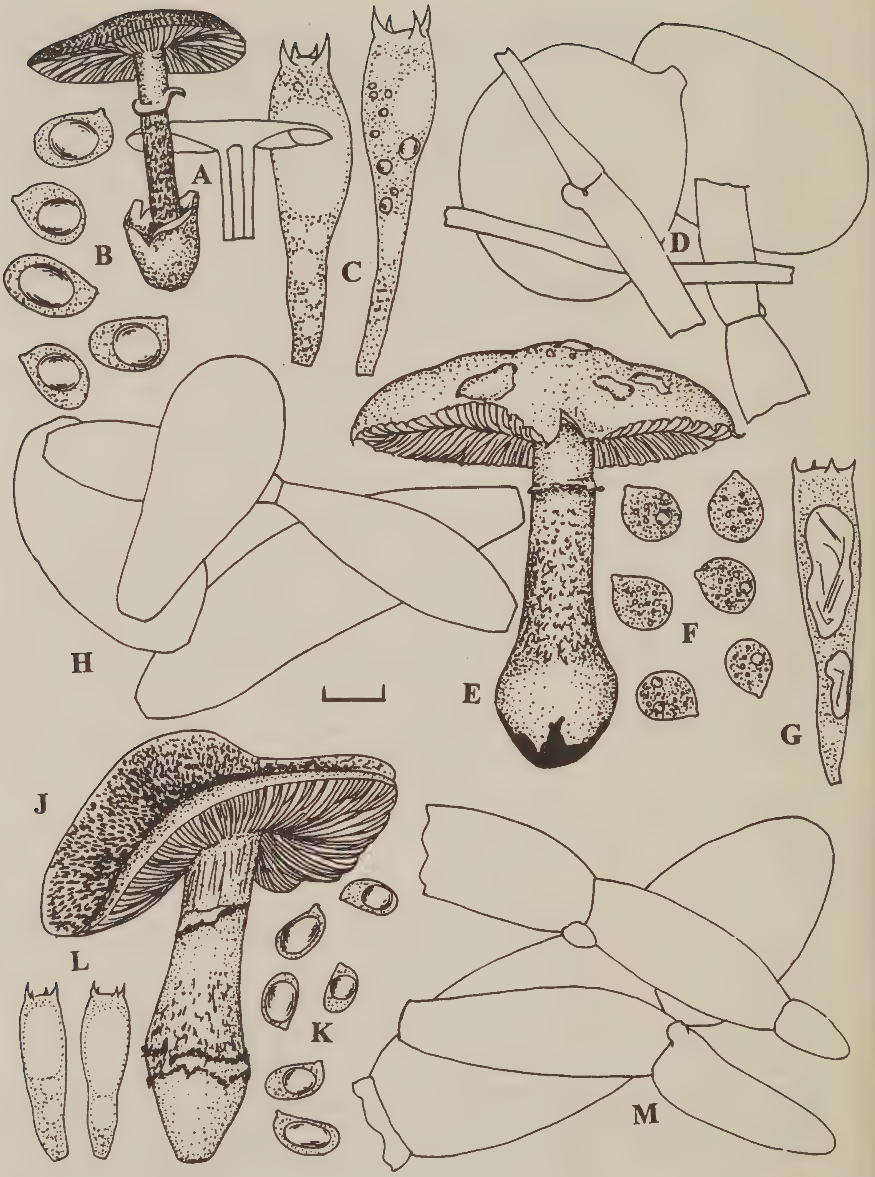

Fig. 3. A - D *Amanita infusca*. **A** habit and section (*Shah-Smith* 137); **B** spores, **C** basidia; **D** velar elements. **E - H.** *A. praeclara*. **E** habit (*Shah-Smith* 115); **F** spores, **G** basidia; **H** velar elements. **J - M** *A. pleropus*. **J** habit (*Shah-Smith* 171); **K** spores, **L** basidia; **M** velar elements. Bar-line: 1 cm for basidioma; 20 μm for micro-structures.

11. Amanita afrospinosa *Pegler & Shah-Smith*, sp. nov.

Pileus 4 - 12 cm latus, late convexus dein depressus, albidus, verrucis magnis pyramidalibus floccosis instructus, ad marginem forte appendiculatus. Lamellae liberae, albidae vel bubalinae, confertae, duabus ordinibus lamellularum intermixtae. Stipes 6.5 - 11 x 1.5 - 3 cm, clavata, ad basim bulbosus subradicatusque, solidus, albidus, scabrosus, annulo supero, albido praeditus, floccoso-viscidus. Volva floccosa, verrucis pyramidalis instructa. Caro crassa, albida, immutabilis, hyphae omnes defibulatae, graveolens, saponacea vel butyracea revocans. Sporae in cumulo albidae, 8 - 9 x 4 - 5 (8.35 ± 0.8 x 4.7 ± 0.33) µm, Q = 1.78, oblongato-ellipsoideae vel cylindricae, hyalinae, amyloideae, tenuitunicatae. Basidia 40 - 50 x 8 - 10 µm, elongato-clavata, 4-sporigera, defibulata. Acies lamellarum sterilis. Trama hymenophoralis bilateralis. Fragmenta volvae cellulis, globosis vel ovo-ellipsoideis brevicatenis composita. Holotypus: *Shah-Smith* 162, K(M)30068.

Pileus 4 - 12 cm diam., broadly convex, finally depressed; surface white, densely coated with erect, detersile, pyramidal, at times truncated verrucae of universal veil which leave circular scars, glabrescent; margin strongly appendiculate, laciniate. *Lamellae* free, white to buff or yellowish brown, broad, crowded, with truncate lamellulae of two lengths; edge appendiculate. *Stipe* 6.5 - 11 x 1.5 - 3 cm, clavate with often cracking, bulbous and tapering base; solid; surface white, bearing floccose-viscid squamules above annulus, scabrous below annulus. *Annulus* thick, floccose, flaring, attached to mid-way zone of stipe, flaring, covered with thick, lanose squamules. *Volva* floccose, white, forming two or three, close, concentric zones over bulbous stipe base, as pyramidal squamules. *Pileal context* thick, white, unchanging, of loosely woven, hyaline, thin-walled hyphae, 3 - 8 µm diam., with fusoid acrophysalides up to 30 µm diam., lacking clamp-connexions; *odour* strong, unpleasant, 'soapy' to 'buttery'. *Spore deposit* white. *Spores* 8 - 9 x 4 - 5 (8.35 ± 0.8 x 4.7 ± 0.33) µm, Q = 1.76, oblong-ellipsoid to short cylindrical, hyaline, amyloid, thin-walled, with refractive contents. *Basidia* 40 - 50 x 8 - 10 µm , elongate clavate, lacking clamp-connexions, tetrasporic. *Lamella-edge* sterile, densely coated with tufts of globose velar elements. *Hymenophoral trama* bilateral, hyaline, of diverging hyphae, 3 - 5 µm diam., inflating to 20 µm diam., lacking clamp-connexions. *Subhymenial layer* 25 - 35 µm wide, pseudoparenchymatous. *Pileipellis* thin cutis, of agglutinated, narrow, hyaline, interwoven hyphae, 2 - 5 µm diam. *Elements of universal veil* 15 - 70 µm diam., globose, ovo-ellipsoid or pyriform, forming short detersile catenate chains of 3 - 5 elements, hyaline, thin-walled, together with few, scattered narrow hyphae, 2 - 5 µm diam., without clamp-connexions. Fig. 4 E - H.

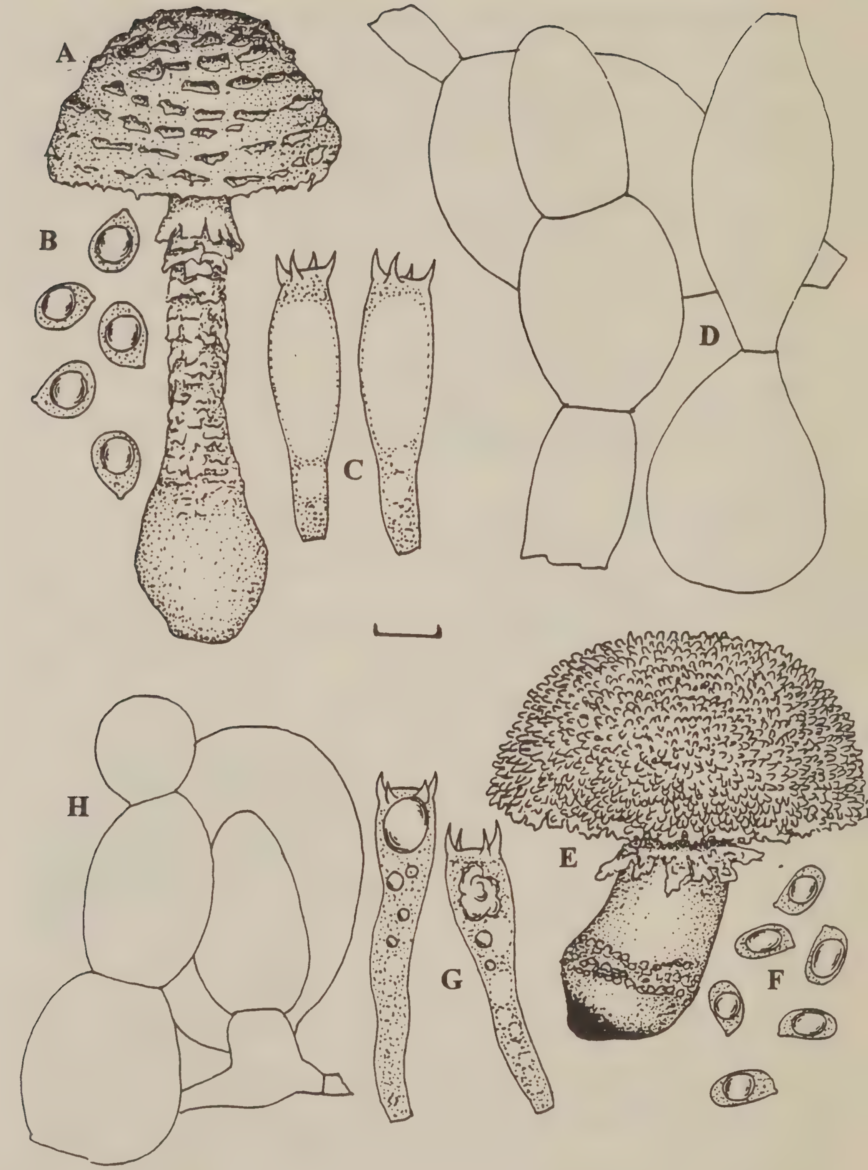

Fig. 4. A - D *Amanita foetidissma*. **A** habit (*Shah-Smith* 49); **B** spores, **C** basidia; **D** velar elements. **E - H** *A. afrospinosa*. **E** habit (*Shah-Smith* 162); **F** spores, **G** basidia; **H** velar elements. Bar-line: 1 cm for basidioma; 20 μm for micro-structures.

SPECIMENS EXAMINED. ZAMBIA, Mpika Distr., North Luangwa Nat. Park, 2 Jan. 1995, *Shah-Smith* 84, K(M)28995; 7 Jan. 1995, *Shah-Smith* 88, K(M)29184; *Shah-Smith* 92, K(M)29181; *Shah-Smith* 90, K(M)29001;25 Jan. 1995, *Shah-Smith* 162, K(M)30068, holotype; 10 Feb. 1995, *Shah-Smith* 198, K(M)29004; Mansa, 8 Dec. 1978, *Rose* 7819, K(M)30069.

The structure of the volva, the elongate spores, the non-marginate and taepering stipe base, together with the pileal colour and the floccose veils place this large, robust species in the Section *Lepidella* Subsection *Solitariae* Bas. The name *Amanita solitaria* (Bull.: Fr.) Mérat, a species described from Europe, has been applied on several occasions to a white species of *Amanita* with pyramidal velar squamules in southern Africa. In particular, Bottomley & Talbot (1954 :38) depict a basidioma with a tall habit and small, glabrescent pileus which may well represent *A. veldiei* Reid & Eicker from Transvaal province, South Africa, although Reid & Eicker (1991) did not find the volval development on the stipe base in the latter species. Levin et al. (1985: 46) illustrate a fungus which closely represents the above species, with a much more robust stature and a dense squamose covering of the pileus. *Amanita solitaria* has been misinterpreted on a number of occasions, representing either *A. echinocephala* (Vitt.) Quél., a species with clamp-connexions (See Bas, 1969: 394) or *A. strobiliformis* (Paulet) Bertillon, a species with large, ovoid spores and large, flattened velar squamules. The present species is probably best placed within the Stirps *Polypyramis* and is distinguished by it large size, pyramidal squamules, the small, short cylindrical spores, and relatively few, uniflated hyphae in the universal veil. *Amanita boudieri* Barla , which also has yellowish lamellae, forms smaller pileal velar-squamules and produces larger spores, measuring 10.5 - 14 x 5 - 7μm. *Amanita veldiei* also has significantly larger spores, measuring 12 - 15 x 7 - 8 μm.

12. Amanita miomboensis *Pegler & Shah-Smith,* sp. nov.

Pileus 7 - 13 cm latus, e convexo expansus, applanatus, siccus, verrucis pyramidalibus roseo-griseis adnatis instructus; margine appendiculato, non striatus. Lamellae liberae, luteolae, ventricosae, confertae, duabus ordinibus lamellarum intermixtae. Stipes 9 - 11 x 1 - 2 cm, cylindricus, ad basim late bulbosus breviter radicatusque, solidus, infra annulum candidus, ad basim griseus, floccoso-squamulis praeditus. Annulus superus, ephemerus. Caro alba, 1.5 cm crassa, immutabilis; hyphae omnes defibulatae. Sporae in cumulo albidae, 8.5 - 10 x 5.5 - 6.5 (9.3 ± 0.5 x 6.3 ± 0.3) μm, late ovoideae vel ellipsoideae, hyalinae, amyloideae, laeves. Basidia 34 - 48 x 9 - 11 µm, elongato-clavata, 4-sporigera, defibulata. Acies lamellarum sterilis. Trama hymenophoralis bilateralis. Fragmenta volvae cellulis globosis vel ellipsoideis, 12 - 30 µm latis, catenis composita. Holotypus: *Shah-Smith* 173, K(M)29971.

Pileus 7 - 13 cm diam., convex to applanate; surface dry, covered with numerous, small, pyramidal, light pinkish grey, soft-floccose verrucae, 1 - 2 mm high, formed from remnants of universal veil, adhering to white ground; verrucae less prominent towards margin; margin appendiculate, non-striate. *Lamellae* free, pale yellow, ventricose, up to 1.2 cm wide, crowded, with truncate lamellulae of two lengths; edge floccose, denticulate. *Stipe* 9 - 11 x 1 - 2 cm, cylindrical, with prominent bulbous, subradicant base (- 4 cm diam.), solid; surface white, subviscid, fibrillose scaly with pinkish grey, indefinite, universal veil remnants covering bulbous base. *Annulus* ephemeral, forming fibrillose zone near stipe apex. *Universal veil* not volvate. *Pileal context* fleshy, up to 1.5 cm thick at disk, white, unchanging, consisting of thin-walled, hyaline hyphae, 4 - 6 µm diam., with fusoid to ellipsoid acrophysalides up to 25 µm diam., clamp-connexions absent. *Spore deposit* white. *Spores* 8.5 - 10 x 5.5 - 6.5 (9.3 ± 0.5 x 6.3 ± 0.3) µm, Q = 1.49, broadly ovoid to short ellipsoid, hyaline, amyloid, thin-walled, with large refractive guttule. *Basidia* 34 - 48 x 9 - 11 µm, elongate clavate, lacking clamp-connexions, tetrasporic. *Lamella-edge* sterile, with scattered, globose to ellipsoid velar elements. *Hymenophoral trama* bilateral, with diverging hyphae 4 - 15 µm diam., hyaline. *Subhymenial layer* 22 - 35 µm wide, loosely pseudoparenchymatous. *Pileipellis* indistinct cutis of repent radially parallel, thin-walled, narrow hyphae, 3 - 4 µm, non-gelatinized. *Universal veil squamules* formed of detersile, chains of hyaline, thin-walled elements, 12 - 30 µm diam., globose to ellipsoid. Fig. 5 A - D.

SPECIMENS EXAMINED. ZAMBIA, Mpika Distr., North Luangwa Nat. Park, *Shah-Smith* 173, K(M) 29971, holotype.

This species is found in open, ‘miombo’ grassland. It resembles *Amanita virginea* Massee from south-east Asia which differs principally in the white universal veil, lacking any grey tints. *Amanita veldiei* Reid & Eicker from Transvaal Province, South Africa is likewise very similar but lacks the grey veil and has larger, more elongate spores. The species is probably best placed within subsection *Solitariae* Bas.

13. Amanita pleropus *(Kalchbr. & MacOwan) Reid* in Contr. Bolus Herb. 7: 130 (1975).

Agaricus pleropus Kalchbr. & MacOwan in Grevillea 9: 17 (1880 as '*pteropus*').

Lepiota pleropus (Kalchbr. & MacOwan) Sacc., Syll. Fung. 5: 35 (1885 as '*pteropoda*').

Pileus 8 - 12 (-16) cm diam., initially subglobose to strongly convex then applanate to depressed; surface densely coated with small, verrucose to pyramidal, velar squamules, up to 1 mm high at disk, varying from pinkish to dark brick-red, on yellowish cream-coloured ground; squamules more fibrilloso-squarrose towards margin; margin exceeding hymenophore and appendiculate. *Lamellae* free, off-white to cream-colour, up to 13 mm wide, subdistant, with truncate lamellulae; edge entire. *Stipe* 7.5 - 11 x 1 - 3 cm, cylindrical to slightly expanded at base; surface creamy white, smooth above annulus, finely reticulate with appressed squamules below annulus, with several zones or ridges towards the bulbous base representing the volval remnants, subradicant. *Annulus* membranaceous, creamy white, with granulose lower surface, pendulous. *Universal veil* not volvate.. *Pileal context* white to cream-colour, up to 1 cm thick, firm; consisting of thin-walled, loosely woven hyphae, with fusoid acrophysalides up to 25 µm diam., with abundant clamp-connexions; *odour* nil or faint and then 'soapy' or sweet nauseous. *Spore deposit* white to cream-colour. *Spores* 7 - 12 x 4 - 7.5 (8.2 ± 0.8 x 5.2 ± 1.0) µm, Q = 1.55, ovoid to elongate ellipsoid, hyaline, amyloid, thin-walled. *Basidia* 25 - 30 x 7 - 8 µm, clavate, with clamp-connexions, tetrasporic. *Lamella-edge* fertile. *Hymenophoral trama* distinctly bilateral, with lateral strata of inflating hyphae, 4 - 18 µm diam., very thin-walled, with clamp-connexions. *Subhymenial layer* loosely pseudoparenchymatous, 20 - 30 µm wide. *Pileipellis* a thin, repent cutis, of radially parallel, non-gelatinized hyphae, 2 - 4.5 µm diam. *Velar remnants* formed of chains of subglobose, doliform, fusoid or cylindrical elements, 13 - 85 (-120) x 7 - 30 µm, thin-walled and hyaline or with brownish wall. Fig. 3 J - M.

SPECIMENS EXAMINED. ZAMBIA, Mpika Distr., North Luangwa Nat. Park, *Shah-Smith* 115, K(M)20012. REPUBLIC OF SOUTH AFRICA, Natal Province, Inanda, 1879, *Wood* A392, K(M)29941 (holotype); A345, K(M)29943; A356, KM29942; Eastern Cape Province, Somerset East, Mt. Boschberg, *MacOwan* 1120, K(M)29944; Transvaal Province, Pretoria, 20 Nov. 1983, *Westhuizen & Roux*, K(M)29946; Pretoria, 17 Feb. 1989, *Eicker*, K(M)15594.

A grassland species and known to form fairy-rings on lawns, widespread in occurrence in South Africa but not previously reported from Zambia. The overall appearance of the basidiomata can vary considerably according to the brown remnants of the universal veil, varying from densely verrucose-squamose and dark coloured to sparsely squamose revealing the pale pileal context. Comparison has been made in the past with *Amanita rubescens* (Fr.) Gray which differs macroscopically by the reddening of the context and surfaces, and the pale grey velar squamules. The latter species, however, lacks the appendiculate pileal margin of *A. pleropus* and is better placed in the Section *Validae* (Fr.) Quél. rather than the Section *Lepidella.* Good colour photographs are provided by Westhuizen & Eicker (1994), and a half-tone photograph by Reid (1991, fig.48). A detailed account of the type material was provided by Reid (1975: 129, fig. 20A) and a full account of the South African material by Reid & Eicker (1991).

Section **4. Validae** *(Fr.) Quél.* in Mém. Soc. Emul. Montbéliard sér. 2, 5: 69 (1872).

14. Amanita rubescens *Pers.*, Tent. Disp. Meth. Fung., suppl.: 71 (1797).

Pileus 6 - 12 (-15) cm diam., subglobose then convex to applanate or finally depressed; surface separable, reddish brown or more yellowish and paler, dry, shiny, initially coated by the whitish to greyish universal veil which disrupts on expansion to form greyish brown squamules, more or less concentrically arranged, easily removed in moist conditions; margin non-striate, appendiculate with small, triangular, velar squamules. *Lamellae* free to almost adnexed, white later pinkish, crowded, with lamellulae of two lengths; edge reddening with age. *Stipe* 6 - 15 x 1 - 2 cm, short cylindrical, swollen at base (- 3 cm diam.), solid; surface whitish soon discolouring pinkish and concolorous with pileus, bruising reddish, finely granulose. *Annulus* membranaceous, persistent, white to cream-colour, upper surface striate; lower surface floccose. *Volva* reduced to slight granulation at stipe base in young basidiomata. *Pileal context* up to 12 mm thick, white, reddening on exposure; consisting of fusoid, ellipsoid to piriform acrophysalides, up to 33 µm diam., lacking clamp-connexions; *odour and taste* mild. *Spores* 7.5 - 10 x 4.5 - 5.5 (8.5 ± 0.7 x 5.3 ± 0.4) µm, Q = 1.60, ellipsoid, hyaline, amyloid, containing single guttule. *Basidia* 35 - 40 x 8 - 10 µm, clavate, tetrasporic. *Lamella-edge* sterile, with numerous, detersile, globose, velar elements; cheilocystidia none. *Hymenophoral trama* bilateral, hyaline, with diverging hyphae, 3 - 5 µm diam., rarely inflating to 13 µm diam. *Subhymenial layer* pseudoparenchymatous, 20 - 30 µm wide. *Pileipellis* agglutinated, repent cutis, of radially parallel hyphae, 3 - 5 µm diam. *Velar squamules* composed of globose elements, 20 - 40 µm diam., intermixed with narrow, scattered hyphae, 2 - 5 µm diam. Fig. 5 E - H.

SPECIMENS EXAMINED. ZAMBIA, Mpika Distr., North Luangwa Nat. Park, in grassland, 2 Jan. 1995, *Shah-Smith* 81, K(M)29984; 20 Jan. 1995, *Shah-Smith* 155, K(M)29985; *Shah-Smith* 169, K(M)29986; 26 Jan. 1995, *Shah-Smith* 172, K(M)29987. MALAWI, Lilangwe, Chaulangue Falls, 13 Jan. 1974, *Allen* 13, K(M)29988. REPUBLIC OF SOUTH AFRICA, Transvaal Province, Barbeton, Darwen Pine Plantation, 14 Feb. 1989, *Reid*, K(M)15591; Ngodwana, Elanshaek Plantation, 13 Feb. 1989, *Reid, Westhuizen & Greaning*, K(M)29989.

Although a cosmopolitan species, it can vary in form and the African basidiomata often appear somewhat more slender in habit in comparison to the European forms. There is also some variation is the spore size range, so that it may become necessary to recognize more than one taxon. The species was possibly introduced into Africa with the pine plantations. The Zambian material, however, was found growing in 'miombo' grassland, possibly associated with *Combretum zeyheri*, *Parinari curatellifolia*, usually in small clusters. Good colour photographs of African collections were published by Buyck (1994: figs. 56 - 57), and a detailed account of South African material was provided by Reid & Eicker (1991).

Section 5. **Phalloideae** *(Fr.) Quél.* in Mém. Emul. Montbéliard sér. 2, 5: 66 (1872).

Amanita phalloides (Vaill.: Fr.) Link is an exotic species which has not yet been recorded from Zambia. Its presence might be expected, however, for there are several records from Tanzania (Pegler, 1977: 296; Härkonen et al. (1995: 59), where it is found in *Acacia* and *Eucalyptus* plantations, and from South Africa (Reid & Eicker, 1991: 87; Westhuizen & Eicker, 1994: 38) where it is commonly found in *Pinus* plantations as well as associated with other exotic trees, such as *Populus* and *Quercus*. Collections have also been received from Zimbabwe.

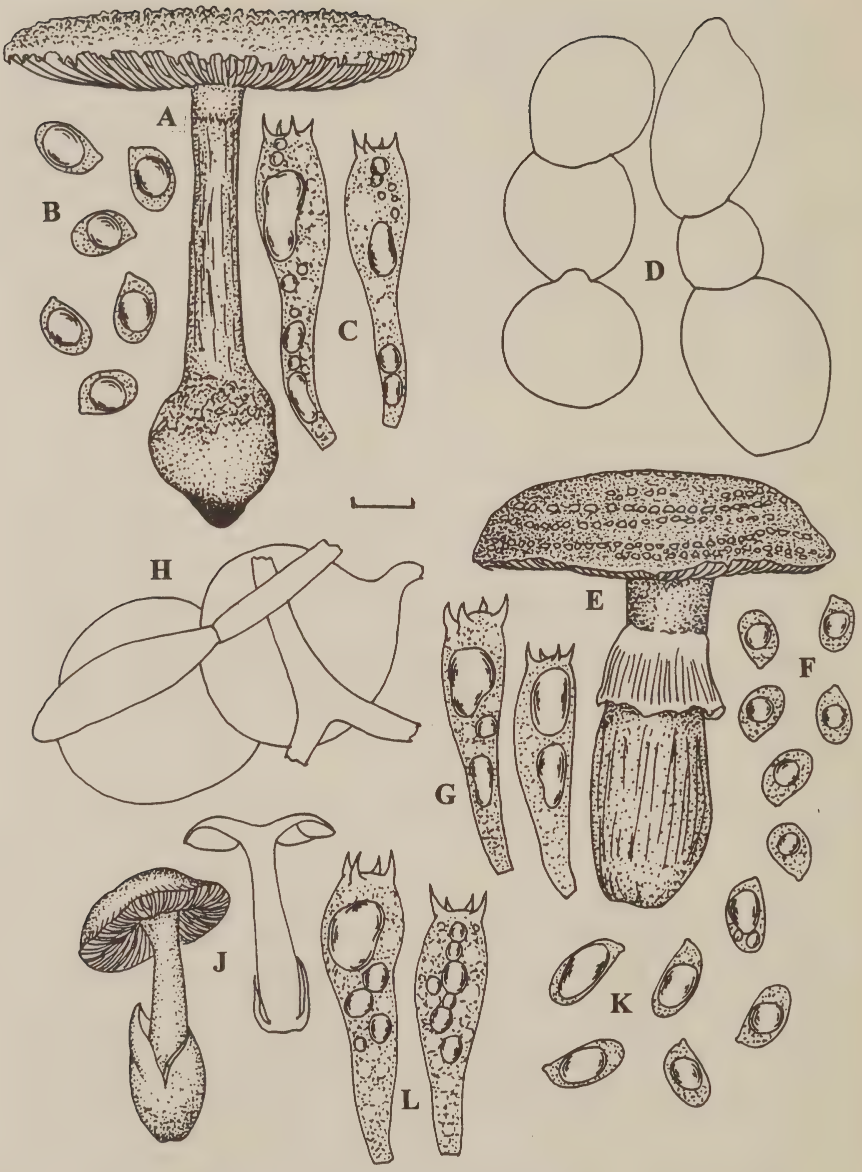

Fig. 5. A - D *Amanita miomboensis*. **A** habit (*Shah-Smith* 173); **B** spores, **C** basidia; **D** velar elements. **E - H** *A. rubescens*. **E** habit (*Shah-Smith* 169); **F** spores, **G** basidia; **H** velar elements. **J - L** *A. subviscosa*. **J** habit and section (*Shah-Smith* 160); **K** spores, **L** basidia. Bar-line: 1 cm for basidioma; 20 µm for micro-structures.

Section **6. Amidella** *(E. J. Gilbert) Konr. & Maubl.*, Agaricales: 61 (1948).

15. Amanita subviscosa *Beeli* in Bull. Soc. Roy. Bot. Belgique 63: 104 (1931).
Amidella subviscosa (Beeli) E. J. Gilbert in Bres., Iconogr. Mycol. 27, suppl. 1 (1): 77 (1940).

Pileus 5.5 - 6.5 cm diam., broadly convex to applanate, depressed at centre; surface whitish to very pale brown with indefinite, concolorous squamules which become smaller and more fibrillose towards margin, viscid; margin striate, undulate. *Lamellae* free, white, drying brown, up to 6 mm wide, crowded, with lamellulae of three lengths; edge denticulate. *Stipe* 6 - 6.5 (- 9) x 0.7 - 1.0 cm, cylindrical, equal or slightly expanding towards base, hollow; surface with whitish to very pale brown or yellowish brown fibrillose squamules on white, unchanging ground, volvate but lacking membranous annulus. *Annulus* ephemeral and soon lost, reduced to faint annulate zone on upper stipe. *Volva* saccate, subterranean, white, membranous-fleshy. *Pileal context* thin especially over hymenophore, soft, white, unchanging, very pale brown under pileipellis, consisting of thin-walled hyphae, 2 - 6 μm diam., with fusoid acrophysalides up to 35 μm diam., lacking clamp-connexions; *odour* 'metallic'. *Spore deposit* white. *Spores* 9.5 - 12 x 5 - 6 (10.7 ± 0.9 x 5.7 ± 0.32) μm, Q = 1.89, elliposid to cylindrical, hyaline, strongly amyloid, thin-walled, with conspicuous refractive contents. *Basidia* 35 - 50 x 10 - 12 μm, clavate, tetrasporic. *Lamella-edge* sterile. *Hymenophoral trama* bilateral, hyaline, with diverging hyphae, 3 - 6 μm diam., inflating to 25 μm diam., lacking clamp-connexions. *Subhymenial layer* 22 - 30 μm wide, pseudoparenchymatous. *Pileipellis* cutis of repent, narrow, hyaline, thin-walled hyphae, 4 - 5 μm diam., not agglutinated. *Volval elements* comprising interwoven hyphae, 4 - 9 μm diam., lacking any inflated elements. Fig. 5 J - L

SPECIMENS EXAMINED. ZAMBIA, Mpika Distr., North Luangwa Nat. Park, 25 Jan. 1995, *Shah-Smith* 160, K(M)28998.

A very pale species which might be confused with species of the Section *Vaginatae* owing to the striate pileal margin and the indefinite annulus. The strongly amyloid, elongate spores and the darkening lamellae are, however, typical of the Section *Amidella*. It was described from the republic of Zaire as growing in a dry forest, conditions similar to the 'miombo' regions of Zambia. Beeli (1931: fig. 8/5; 1935: pl. 2/6) and Gilbert (1941: pl. 37) illustrated the species, although it had only been found on one occasion and has not been recorded since. Beeli (1931) described the spores as measuring 6 - 7 x 4 - 5 µm and ellipsoid, but the drawings made from the type collection by Gilbert (1940: pl. XXVIII/6) show a cylindrical spore, measuring 7 - 9 x 3.5 - 4.5 µm. The slightly larger spore-dimensions of the Zambian material might suggest *A. gossensiae* Beeli, but for the reddish brown pigmentation of the latter species.

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MYCOTAXON

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A name change for Coltricia pusilla (Aphyllophorales)

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Sharma & Wright (1992) published the new binomial *Coltricia pusilla* J. R. Sharma & J. E. Wright for a small stipitate polypore from India, belonging to the Hymenochaetaceae.

This name is illegitimate due to the existence of an earlier homonym, viz., *Coltricia pusilla* Imazeki & Kobayashi (1966) (ICBN, Art. 53.1; Index of Fungi 3: 483, 1966; ibid., 6: 540, 1995) which, incidentally, is not a *Coltricia* but a *Coltriciella*, on account of its rugulose spores, hence ***Coltriciella pusilla*** (Imazeki & Kobayashi) J. E. Wright comb. nov. (basionym: *Coltricia pusilla* Imazeki & Kobayashi, Trans. Mycol. Soc. Japan 7: 42, 1966).

I am therefore proposing to replace the illegitimate name by ***Coltricia parvula*** J. R. Sharma & J. E. Wright, nom. nov. (basionym: *Coltricia pusilla* J. R. Sharma & J. E. Wright, Bull. Bot. Survey India 31[1989]: 182, 1992, nom. illegit.), to provide a legitimate name for this particular taxon.

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TAXONOMY OF DAEDALEA XANTHA COMB. NOV.

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SUMMARY

Morphological and cultural characters of Poria xantha (Fr.) Cke. have been studied in detail and in the light of these findings the taxonomy of the fungus is discussed. The new combination Daedalea xantha (Fr.) Roy & De is proposed.

INTRODUCTION

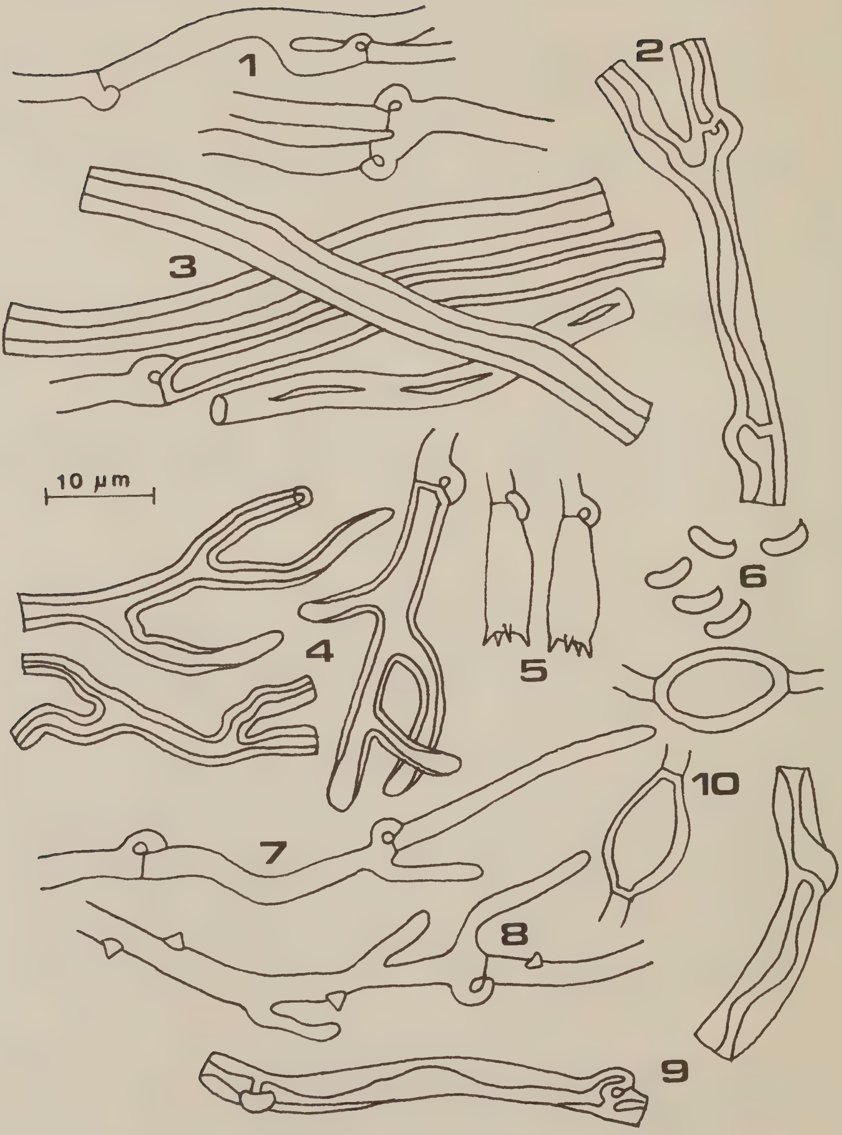
In India Poria xantha (Fr.) Cke. grows on both gymnospermic and angiospermic wood where it causes a brown rot. The present paper reports the results of detailed studies on the morphological and cultural characters of P. xantha. The taxonomy of the species is also discussed in light of these findings and a new combination of the species in the genus Daedalea Pers.: Fr. is proposed.

MATERIALS AND METHODS

Basidiocarps were collected from different parts of India by the authors on frequent excursions during the rainy seasons of 1989-1993. For microscopic characters, freehand sections were teased apart and mounted in lactophenol-cotton blue. Cultures were established from context tissues of these basidiocarps and studied following the methods of Nobles (1948) and Nobles et al. (1957). Oxidase reactions were tested by the Bavendamm method as described by Davidson et al. (1938). Voucher specimens and cultures have been deposited in the Mycological Herbarium, Department of Botany, Visva-Bharati University (VBMH), Santiniketan, West Bengal, India.

DESCRIPTION OF BASIDIOCARPS

Daedalea xantha (Fr.) Roy & De, comb. nov.
Basionym : Polyporus xanthus Fr., Obs. 1: 128, 1815
= Poria xantha (Fr.) Cke., Grevillea 14: 112, 1886


10 µm

Basidiocarp annual, extensively effused, adnate, soft when fresh, chalky white when dry, subiculum less than 1 mm thick, surface cream to sulphur yellow when fresh, fading to white or cream and freely cracking into blocks on drying; pores circular, 5-6 per mm, pore tubes white, up to 3 mm thick.

Hyphal system trimitic. Generative hyphae hyaline, thin-walled, 2-4 µm in diam. (Fig.1), some thick-walled, thickening often irregular (Fig.2), 2.5-7.0 µm in diam. Skeletal hyphae (Fig.3) abundant, hyaline, unbranched, thick-walled to subsolid, 2.2-6.5 µm in diam. Binding hyphae (Fig.4) few, hyaline, shortly branched, 2.5-5.0 µm in diam. Both the skeletal and binding hyphae rarely showed thin-walled clamped cell at their basal septa. Basidia (Fig.5) clavate, 4-sterigmate, 10-15 x 4-5 µm. Basidiospores (Fig.6) allantoid, hyaline, thin-walled, 4.0-5.0 x 1.0-1.5 µm. The spore sizes with data on the number of spores measured and the number of the specimens examined are given below :

Number of the specimens	Number of spores measured	Basidiospore sizes
VBMH 89901	20	4.5-5.0 x 1.2-1.5 µm
VBMH 89902	20	4.0-5.0 x 1.0-1.5 µm
VBMH 90903	20	4.0-4.5 x 1.0-1.3 µm
VBMH 91904	20	4.0-5.0 x 1.0-1.5 µm
VBMH 93905	20	4.0-5.0 x 1.0-1.4 µm
VBMH 93906	20	4.0-5.0 x 1.0-1.5 µm

SPECIMENS EXAMINED : VBMH 89901 and VBMH 89902, growing on dead wood of *Pinus excelsa* Wall. ex Don, Sojar, Suraj Division (Punjab); VBMH 90903, on a dead branch of *Pinus wallichiana* Jacks., Pulga (H.P.); VBMH 91904, growing on log of *Quercus semecarpifolia* Sm., Banjar Range (Punjab); VBMH 93905, on log of *Quercus semecarpifolia* Sm., Toshnal (H.P.); VBMH 93906, on log of *Quercus semecarpifolia* Sm., Kulu (H.P.).

DESCRIPTION OF CULTURE

Growth characteristics : Growth moderately rapid, plates covered in 3-4 weeks. Advancing zone even, raised, aerial mycelium extending to the limit of growth. Mat white, cottony to start with, soon collapsed, translucent and cream in colour with patches of woolly mycelium scattered and also along the edges of the petri dish. Reverse unchanged.

Oxidase reactions : Negative on both gallic acid and tannic acid agar, growth 2.5 cm in diameter on the former and nil or trace on the latter.

Microscopic characters : Advancing zone - hyphae hyaline, thin-walled, clamped, 2.5-5.5 µm in diam. (Fig.7).

Aerial mycelium - (a) hyphae hyaline, thin-walled, frequently sprouting, occasionally with small thickened refractive projections on the walls (Fig.8), sometimes broken at short lengths, often with distinct irregular thickening (Fig.9), 3.0-5.5 µm in diam.; (b)

Figs.1-10. *Daedalea xantha*. 1-6. Microscopic structures from basidiocarp. 1. Thin-walled generative hyphae. 2.Generative hypha with irregular wall thickness. 3.Skeletal hyphae. 4.Binding hyphae. 5.Basidia. 6.Basidiospores. 7-10.Microscopic structures from culture. 7.Hypha from advancing zone. 8.Thin-walled clamped aerial hypha with small thickened refractive projections on the wall. 9.Clamped hyphae with irregular wall thickness. 10.Chlamydospores.

chlamydospores (Fig.10) occasionally present, 12-18 x 6-7 µm.
SEXUALITY : The result of pairing of 20 monosporous cultures obtained from a fresh basidiocarp (VBMH 93906) shows the species to be bipolar with the following distribution of mating types among the basidiospores.

A_1 : 1,4,5,7,11,12,13,17,18

A_2 : 2,3,6,8,9,10,14,15,16,19,20

SPECIES CODE : 1.3.7.9.(34).36.38.43.44.54.55
[following the system of Nobles (1965)]

CULTURES EXAMINED : VBMH 89901, 90903, 91904, 93905 and 93906.

GLOBAL DISTRIBUTION : Argentina (Rajchenberg 1984), Australia (Melo 1984), India (Rattan 1977), New Zealand, North America, Portugal (Melo 1984), former USSR (Bakshi 1971), Yugoslavia (Tortic 1988).

DISCUSSION

The aforesaid description indicates that *Poria xantha* has a trimitic hyphal system and thus contradicts the views held by earlier workers (Bakshi 1971, Rattan 1977, Melo 1984, Rajchenberg 1984, Gilbertson and Ryvarden 1986, Rayvarden and Gilbertson 1990) who considered it as dimitic with generative hyphae and skeletal hyphae. Bakshi (1971), Rattan (1977), Gilbertson and Ryvarden (1986) and Ryvarden and Gilbertson (1990) recorded the rare presence of branched skeletal hyphae. We also noted the occurrence of aseptate thick-walled hyphae with short branches in all the basidiocarps though they were few in number. Our critical observations revealed that they were true binding hyphae and not branched skeletals as reported by the earlier workers because they were short, branched with many short branches and showed thin-walled clamped cell at their basal septa. Therefore, *P. xantha* is not dimitic but trimitic in construction with scanty and rudimentary binding hyphae. It may be mentioned here that we have recorded some thick-walled clamped generative hyphae in *P. xantha* which often showed irregular wall thickening. This type of generative hyphae have also been recorded by Rajchenberg (1984) although these have not been observed by Gilbertson and Ryvarden (1986) and Ryvarden and Gilbertson (1990).

P. xantha has been described by several authors under different genera viz. *Amyloporia*, *Antrodia* and *Poria*. But *P. xantha* shows the closest resemblance with *Daedalea quercina* L.: Fr., the type species of the genus *Daedalea*. Although Van der Westhuizen (1971), from comparative cultural and anatomical studies on *D. quercina*, concluded it to be a dimitic species, the prevailing opinion, see Cunningham (1948), Teston (1953), Kotlaba and Pouzar (1957), Domanski et al. (1973), and Ryvarden (1976), is that this species is trimitic with 'scanty and rudimentary' binding hyphae (Reid 1976). In possessing a trimitic hyphal system with thin-walled as well as thick-walled generative hyphae including generative hyphae with characteristic irregular wall thickening (Van der Westhuizen 1971), skeletal hyphae and scanty and rudimentary binding hyphae (Reid 1976) *D. quercina* closely resembles *P. xantha*. Besides, like *P. xantha*, *D. quercina* causes a brown rot, produces no extracellular oxidase in culture and possesses a bipolar type of sexuality (Nobles 1965). The species code of *D. quercina* (Nobles 1965) also comes close to that of *P. xantha*. So many features in common suggest a close relationship between *P. xantha* and *D. quercina*.

Therefore, it is concluded that *P. xantha* and *Daedalea quercina* are congeneric and the following new combination is proposed: *Daedalea xantha* (Fr.) Roy & De, comb. nov.

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ALLOZYME CHARACTERIZATION OF SOME TERFEZIACEOUS FUNGI (PEZIZALES, ASCOMYCOTINA)

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Abstract: Two species of *Terfezia* (*T. arenaria, T. boudieri*), two *Tirmania* species (*T. nivea, T. pinoyi*) and *Picoa lefebvrei* were characterized by allozyme analysis. Only the Egyptian population of *Tirmania nivea* appeared fixed like individuals in *Tuber*, while all the other species showed heterozygosity suggesting reproduction *via* outbreeding. A clear difference arises between *Terfezia*, heterozygous for some enzymes, and *Tuber*, always homozygous.

Key Words: Tuberales, reproduction, genetics, systematics.

INTRODUCTION

Terfeziaceous fungi are hypogeous Ascomycotina in the Pezizales (Korf, 1972) or alternatively classified as Tuberales (Fisher, 1897).
Several authors have regarded hypogeous fungi, namely truffles of the genus *Tuber*, as heterogamic species since Dangeard (1895/96). However the allozyme patterns obtained with electrophoretic analyses show that all the examined taxa of *Tuber* are homozygous for fourteen enzymes (Pacioni & Pomponi, 1989; Pacioni & Pomponi, 1991; Pacioni *et al.*, 1993). The explanation of this phenomenon may be that either the truffles are self-fertilizing species (Pacioni, 1992; Pacioni *et al.*, 1993) or that truffle morphotaxa are a cluster of clones reproductively isolated (Bullini *et al.*,1994), in spite of earlier reports of heterogamy (Fasolo-Bonfante & Brunel, 1972).

According to evolutionary hypotheses, Tuberales have evolved from Pezizales, that is the former series of Discomycetes (Malençon, 1938; Korf, 1972; Trappe, 1979), however there is general agreement that this order might be polyphyletic. Zhang (1992) confirmed polyphyly in the Tuberales on the basis of the ascospore nuclear numbers, indicating a clear correlation between epigean families of Pezizales and genera of Tuberales. These data showed *Tuber* spores with two or many nuclei. Consequently a heterogamic system of reproduction is unlikely. On the other hand, several genera of Tuberales produce monokaryotic spores , because there are eight per ascus, and are thus likely aploid.

To add more information on the reproductive system of Tuberales, several genera of hypogeous Ascomycotina were surveyed by electrophoretic analysis.

MATERIALS AND METHODS

Eighteen specimens of *Terfezia arenaria* (Morris)Trappe were collected in Sardinia, beneath *Tubercularia guttata* (L.)Fourr., Oristano, 21 Apr 1992.

Specimens of *Terfezia* collected from northern Egypt (Sidi Barrani airport, *Helianthemum sp*., 28 Feb 1992) were immature and were excavated from an experimental plot containing three *Terfezia* species (*T. claveryi, T. boudieri* and *T. arenaria*). Because of the structure of the peridium they were tentatively identified as *Terfezia boudieri*, however *T. arenaria* has the same type of peridium. Despite the similarity in peridial structure, it is doubtful that they were *T. arenaria* because this latter species only occurs in Sidi Barrani after irrigation (Pacioni & El-Kholy, 1994).

A single specimen of *Tirmania pinoyi*, eight of *Tirmania nivea* and three of *Picoa lefebvrei* all came from northern Egypt (*Helianthemum sp*., Sidi-Barrani airport, 28 Feb 1992). Fourteen specimens of *Tirmania pinoyi* were collected at an undetermined site near the border of Turkey and Syria in early April, arriving in L'Aquila on 14 Apr 1994.

After determination, sporocarps were preserved, one portion cut in little sticks and then frozen and a second portion dried and stored in the Herbarium of L'Aquila (AQUI) as a voucher.

Horizontal starch gel electrophoresis (SGE) was conducted at a constant 8v/cm for approximately 3.5 hours at 4°C. The specific stainings were done according to Harris (1966), except for SKDH stain (Fineschi,1983). The list of the studied enzymatic loci with details on techniques are given in Table 1.

The mobility of the enzymes of *Tuber melanosporum* Vitt. (=100) was used as a standard.

Electrophoretic data were analysed using the NTSYS-pc program (Rohlf, 1987).

Table 1. SGE conditions for detection of isozymes and allozymes.

enzymes	E.C. number	buffer	pH	references
ME	1.1.1.40	1	8.2	HARRIS (1966)
IDH	1.1.1.42	1	8.2	BREWER & SING (1970)
6PGD	1.1.1.44	3	8.0	SHAW & PRASAD (1970)
G6PD	1.1.1.49	1	8.2	BREWER & SING (1970)
SOD	1.15.1.1	1	8.2	HARRIS (1966)
HK-1	2.7.1.1	3	8.0	SHAW & PRASAD (1970)
AK	2.7.4.3	2	7.2	BREWER & SING (1970)
PGM	2.7.5.1	2	7.2	BREWER & SING (1970)
MPI-1	5.3.1.8	3	8.0	HARRIS (1966)
PGI	5.3.1.9	1	8.2	BREWER & SING (1970)
SKDH	1.1.1.25	3	8.0	ROTHE (1973)

Buffer systems used: **1**- Lithium/borate (SHAW & PRASAD, 1970); **2**- Tris/maleate (BREWER & SING, 1970); **3**- Tris/versene/borate (SHAW & PRASAD, 1970)

RESULTS

The allele frequencies of the eleven loci scored in the population examined are shown in Table 2, as are three parameters of genetic variability: P%, proportion of polymorphic loci; A, mean number of alleles per locus and H°, observed mean heterozygosity. Data from the single specimen of *Tirmania pinoyi* from Egypt were not included in Table 2, where data populations are presented.

The eight specimens of *Tirmania nivea* all had monomorphic loci with alleles that seem to be fixed in individuals.

The fourteen sporophores of *Tirmania pinoyi* from Turkey, in constrast, exhibited polymorphic loci and thirteen appeared heterozygous at locus HK-1. The single specimen from Egypt was heterozygous at locus G6PD (alleles 100/105), and its pattern was: SOD-1 80, SKDH 105, PGI 105, HK-1 87, 6PGD 90, AK 102, PGM 80, IDH 100, MPI-1 100, ME 100.

Both species of *Terfezia* showed heterozygosity and polymorphism.

The eighteen specimens of *Terfezia arenaria* have nine monomorphic loci and two polymorphic loci (PGM, MPI-1), among which only the *Pgm* allele was heterozygous with a low value of H°, 0.07. Nine loci are polymorphic in *Terfezia boudieri*, and four (*G6PD, HK-1, PGM, MPI-1*) heterozygous with a higher value of H°, 0.20.

The three specimens of *Picoa lefebvrei* have four monomorphic loci and seven polymorphic loci (G6PD, SOD, PGI, HK-1, PGM, MPI-1, ME). The MPI-1, PGM and HK-1 loci are also heterozygous with 0.18 of H°.

The *Tuber melanosporum* analysis confirms its homozygosity.

DISCUSSION

In order to evaluate the phylogenetic hypothesis of TRAPPE (1979) members of four families of Pezizales were examined: Pezizaceae (*Tirmania*), Balsamiaceae (*Picoa*), Terfeziaceae (*Terfezia*), Tuberaceae (*Tuber*).

Because of the small number of specimens examined and the difficulty in finding further ascomata for analysis, these results cannot be discussed exhaustively. However the heterozygosities detected in *Tirmania* (*T. pinoyi*), *Terfezia* (*T. arenaria, T. boudieri*) and *Picoa* (*P. lefebvrei*) indicate some crossing or hetero- or homotallism, as might be expected for the mating systems of species with aploid spores. The population of *Tirmania nivea*, in constrast to *T. pinoyi*, is homozygous like the *Tuber* species studied by Pacioni *et al.* (1993).

At present, we do not know the types of reproduction mechanisms producing homozygosity in *Tirmania nivea* and in *Tuber*. The ascospore nuclear number of *Tirmania* is also unknown, however since there are eight spores per ascus, primary homothallism might occur in *T. nivea*, while *Tuber*, having two or many nuclei per spore, apomixis seems plausible.

At this stage it appears more likely that several reproductive systems occur within hypogeous Ascomycetes supporting the polyphyly hypothesis. As a consequence, the order of Tuberales needs further research to determine its systematic status as it appears more and more a product of evolutionary convergence of organisms systematically distant (Pacioni, 1992).

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Table 2. Allele frequencies observed at 11 loci analysed in population samples of the species of *Tirmania*, *Terfezia* and *Picoa* and parameters of genetic variability. *P* proportion of polymorphic loci; *A* mean number of alleles per locus; H^{o} Observed mean heterozygosity. Standard *Tuber melanosporum*=100.

		Tirmania nivea	*Tirmania pinoyi*	*Terfezia arenaria*	*Terfezia boudieri*	*Picoa lefebvrei*
specimens		8	14	18	4	3
Locus	Alleles					
G6PD	95	- (0)	- (0)	1.00 (0)	0.50 (3)	- (0)
	100	1.00	1.00	-	0.37	0.33
	105	-	-	-	0.13	-
	110	-	-	-	-	0.67
SOD-1	55	- (0)	- (0)	- (0)	0.50 (0)	- (0)
	68	-	-	-	0.50	0.33
	80	1.00	-	1.00	-	0.67
	90	-	1.00	-	-	-
SKDH	90	- (0)	1.00 (0)	- (0)	- (0)	- (0)
	95	-	-	1.00	-	-
	100	1.00	-	-	0.25	-
	105	-	-	-	0.75	1.00
PGI	100	1.00 (0)	- (0)	- (0)	- (0)	- (0)
	105	-	-	-	1.00	0.67
	107	-	1.00	-	-	-
	110	-	-	1.00	-	0.33
HK-1	87	- (0)	- (13)	- (0)	0.50 (1)	- (2)
	90	-	-	-	0.13	0.33
	91	-	0.46	-	-	-
	95	-	-	-	0.37	0.33
	96	-	0.46	-	-	-
	100	1.00	0.07	1.00	-	0.33
6PGD	90	- (0)	- (0)	- (0)	0.25 (0)	- (0)
	95	-	1.00	-	0.25	-
	100	-	-	1.00	0.50	1.00
	105	1.00	-	-	-	-
AK	95	- (0)	0.93 (0)	- (0)	- (0)	- (0)
	100	-	0.07	-	0.25	-
	102	1.00	-	1.00	0.50	-
	110	-	-	-	0.25	-
	125	-	-	-	-	1.00

PGM	80	1.00 (0)	- (0)	0.03 (14)	0.37 (2)	- (1)
	84	-	1.00	-	-	-
	85	-	-	0.39	0.13	0.83
	90	-	-	0.58	-	0.17
	95	-	-	-	0.13	-
	100	-	-	-	0.37	-
IDH	100	- (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)
	102	1.00	-	-	-	-
MPI-1	85	- (0)	- (0)	- (0)	0.25 (3)	- (3)
	90	-	-	-	0.50	0.17
	95	-	-	-	0.25	0.50
	98	-	-	-	-	0.17
	100	-	0.93	0.39	-	0.17
	105	-	0.07	0.61	-	-
	107	1.00	-	-	-	-
ME	80	- (0)	- (0)	1.00 (0)	- (0)	- (0)
	85	-	-	-	0.25	-
	90	-	-	-	0.50	-
	95	1.00	0.25	-	0.25	-
	98	-	-	-	-	0.33
	100	-	0.75	-	-	-
	103	-	-	-	-	0.67
	P%	0	36.3	18.1	81.8	63.6
	A	1	1.45	1.27	2.45	1.9
	H^o	0	0.08	0.07	0.20	0.18

A locus is regarded as polymorphic when the frequency of the most common allele is under 0.95%.

Numbers at right in parentheses show the number of heterozygotes found per each locus.

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WEDDELLOMYCES PROTEARIUS SP. NOV. ET *LICHENOCHORA XANTHORIAE*, CHAMPIGNONS LICHÉNICOLES NON LICHÉNISÉS PARASITES DE *CALOPLACA PROTEUS*

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Résumé : Découverte de deux champignons lichénicoles non lichénisés sur des spécimens de *Caloplaca proteus* d'Allemagne et d'Autriche. *Weddellomyces protearius* sp. nov. diffère de *W. erythrocarpae* par des spores un peu plus petites, à torus des cloisons non proéminents. *Lichenochora xanthoriae* Triebel et Rambold est mentionné pour la première fois en Europe.

Resumo : Malkovro de du nelikeniĝintaj fungoj likenloĝaj ĉe specimenoj de *Caloplaca proteus* el Germanio kaj Aŭstrio. *Weddellomyces protearius* sp. nov. diferencas de *W. erythrocarpae* pro sporoj iom pli malgrandaj, kun septotoroj ne elstaraj. *Lichenochora xanthoriae* Triebel et Rambold estas unuafoje menciita en Eŭropo.

Resumen : Mención de dos hongos liquenícolas no liquenizados sobre ejemplares de *Caloplaca proteus* de Alemania y Austria. *Weddellomyces protearius* sp. nov. se diferencia de *W. erythrocarpae* por las esporas algo menores, provistas de un toro no prominente. *Lichenochora xanthoriae* Triebel et Rambold se cita por primera vez en Europa.

Abstract: Discovery of two non-lichenised lichenicolous fungi growing on *Caloplaca proteus* from Germany and Austria. *Weddellomyces protearius* sp. nov. differs from *W. erythrocarpae* by smaller spores with septa tori not prominent. *Lichenochora xanthoriae* Triebel et Rambold is reported for the first time from Europa.

Introduction

Au cours de recherches sur la taxinomie des *Verrucaria* du groupe de *V. granulosaria*, parasites du genre *Caloplaca*, les auteurs ont observé deux champignons lichénicoles non lichénisés sur *Caloplaca proteus* Poelt. L'un, appartenant au genre *Weddellomyces*, ne figure pas dans la révision récente de NAVARRO-ROSINÉS et ROUX (1995) et constitue donc une nouvelle espèce, que nous nommons *W. protearius*. L'autre, appartenant au genre *Lichenochora*, correspond tout à fait à la description de *L. xanthoriae* (TRIEBEL et al. 1991), espèce qui n'était jusqu'ici connue, sur *Xanthoria elegans* (Link) Th. Fr., qu'en Amérique du Nord.

Weddellomyces protearius Nav.-Ros. et Roux sp. nov.

Weddellomyces erythrocarpae *Nav.-Ros. et Roux similis, sed sporis minoribus, (25)27-33(39) × 11-14 µm, cum levi interna perispora neque prominentibus toris instructis. Immersus in* Caloplacae proteus *thallo.*

Types : Allemagne, Ammergauer Alpen, Oberbayern, südseitiger Überhang eines Felssturzes, südöstlich des Laber bei Oberammergau, 1966/08/11. Leg. J. POELT. GZU (holotype et isotype).

Ascomes périthécioïdes, noirs, isolés sur le thalle de l'hôte, d'abord complètement enfoncés dans celui–ci, puis érumpants et bien visibles, globuleux, de 240-350 µm de diamètre, à surface légèrement rugueuse et à ostiole légèrement déprimé, à ouverture irrégulière, en forme de fissures radiales.

Excipulum montrant la structure typique du genre (voir NAVARRO-ROSINÉS et ROUX 1995), constitué de deux couches :

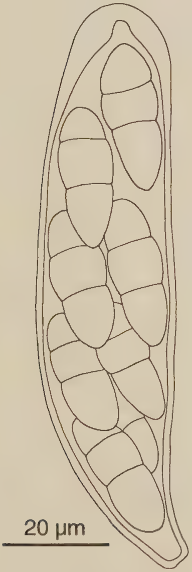
- L'externe (de 20–26 µm d'épaisseur à la base, jusqu'à 50 µm au sommet) de couleur brun sombre, pseudoparenchymateuse (= paraplectenchymateuse), munie, dans la moitié supérieure, de plaques céphalothécioïdes (Hawksworth, 1986).

- L'interne formée d'une ou deux couches de cellules incolores.

Hamathécium constitué par des filaments interascaux (paraphysoïdes, selon le concept de l'école française de Chadefaud) cloisonnés, abondamment ramifiés et anastomosés, de 1,5–2,5 µm d'épaisseur. Périphyses s.l. absentes.

Asques (fig. 1) à structure conforme à celle du genre, étroitement claviformes, de 105-140 × 21-25 µm, octosporés.

Spores (fig. 2-3) de (24,5)27-*29,7*-32,5(39) × (10,5)11-*12,1*-13,5(14,5) µm (38 spores mesurées), à rapport longueur sur largeur de (2)2,2-*2,5*-2,7(2,9), ellipsoïdales, hétéropolaires (une extrémité arrondie, l'autre moins large et un peu atténuée), la plupart à 2-3 cloisons transversales, quelques-unes à seulement 1 cloison, rétrécies au niveau de ces cloisons, à torus non proéminents, souvent peu visibles, à périspore interne non granuleuse et entourée d'une mince périspore externe (≤ 0,5 µm), peu visible.



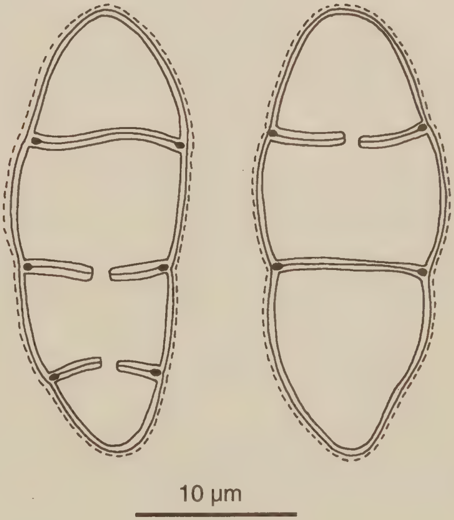


Fig. 1 — Asque de *Weddellomyces protearia* contenant 8 spores (observé dans l'eau).

Fig. 2 — Structure de deux spores de *Weddellomyces protearia* (observées dans l'eau).

Mycélium formé d'hyphes en relation avec la base des ascomes, incolores, à cellules courtes et à paroi épaisse (1-2 µm).

Réactions : Toutes les parties (végétatives et reproductrices) sont I –.

Remarques : Cette espèce se rapproche de *W. erythrocarpae* (NAVARRO-ROSINÉS et ROUX, 1995) par des spores à paroi non granuleuse, mais celles-ci sont un peu plus petites et munies de torus non proéminents, peu visibles. *W. heterochrous* a également des spores à paroi lisse, de taille assez voisine, mais les cellules de leurs extrémités sont nettement plus claires et à paroi plus mince.

Répartition géographique et habitat : *W. protearius* n'est connu que par deux spécimens de la localité type, sur thalle de *Caloplaca proteus.*

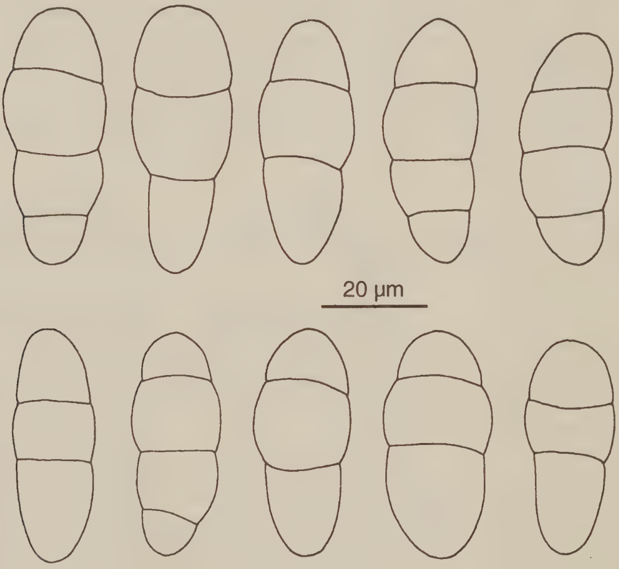


Fig. 3 — *Weddellomyces protearia.* Variabilité de la forme et de la septation des spores (observées dans l'eau).

Clé de détermination des *Weddellomyces*

La clé de détermination des *Weddellomyces* proposée par NAVARRO-ROSINÉS et ROUX (1995) doit être modifiée de la façon suivante :

11 Spores (40)49–66(71) × 12–20(24) µm, à rapport longueur/largeur d'environ 3–4, 3(4)–septées, munies d'un halo épais (atteignant 10 µm). Asques de 125–170 × 35–40 µm. — Parasite d'*Aspicilia calcarea*. îles Britanniques (pays de Galles) et Espagne (Catalogne, Pays basque) — ***W. macrosporus*** D. Hawksw., Renobales et Coppins

1 Spores plus petites, à rapport longueur/largeur < 3, entourées d'un halo de 0,5–3 µm d'épaisseur, généralement peu visible.

22 Spores mûres à surface lisse ou très finement granuleuse.

33 Cloisons des jeunes spores munies de torus non proéminents, souvent peu visibles. Spores (25)27-33(39) × 11-14 µm, (1)2-3–septées. Asques 105-140 × 21-25 µm. — Parasite de *Caloplaca proteus*. Allemagne — ***W. protearius*** Nav.–Ros. et Roux

3 Cloisons des jeunes spores munies de torus proéminents.

44 Spores 30–40(45) × 11–15 µm, d'un brun doré uniforme, à paroi d'épaisseur égale, (1)2(3) septées. Asques de 130–160 × 20–24 µm. — Parasite de *Caloplaca erythrocarpa*. Espagne (Catalogne) — ***W. erythrocarpae*** Nav.–Ros. et Roux

4 Spores 26–36(38) × 11–13(15) µm, à cellules apicales nettement plus claires que les médianes et à paroi nettement amincie, (2)3(5) septées. Asques d'environ 100–150 × 20–26 µm. — Parasite d'*Aspicilia calcarea*. Espagne (Catalogne) — ***W. heterochrous*** Nav.–Ros. et Roux

2 Spores mûres à surface nettement granuleuse–verruqueuse. Cloisons des jeunes spores à torus non proéminents, souvent peu visibles.

33 Spores brun sombre ou noires à maturité, de 21–31 × 9–13 µm, 3–septées, généralement unisériées. Asques de 100–200 × 16–22 µm, cylindriques. — Parasite d'*Aspicilia radiosa*. Slovaquie, Allemagne, France* — ***W. aspiciliicola*** Alstrup

3 Spores brun clair ou brun doré (dans l'eau !), bisériées. Asques claviformes, ne dépassant pas 120 µm de longueur.

44 Spores 24–31(38) × 9–12(14) µm, 2–3(5)–septées. Asques 90–120 × 20–25 µm. — Parasite de *Caloplaca* gr. *aurantia*, *C.* gr. *variabilis* et de *Protoblastenia rupestris*. Allemagne, Espagne, France, îles Britanniques, Sardaigne — ***W. epicallopisma*** (Weddel) D. Hawksworth

4 Spores 21–26(30) × 8–10 µm, (1)2-3(4)–septées. Asques 80–90 × 18–20 µm. — Parasite d'*Aspicilia gr. calcarea*. Espagne (Catalogne) — ***W. pachyosporicola*** Nav.–Ros. et Roux

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* *W. aspiciliicola* Alstrup est signalé pour la première fois en France : Saône–et–Loire, Maconnais, NE de Cluny, collines calcaires des environs de Blanot, alt. c. 500 m. 1996/05/18. Leg. P. Navarro–Rosinés.

Lichenochora xanthoriae Triebel et Rambold

Ascomes (périthèces) dispersés, noirs, visibles seulement par leur sommet d'aspect punctiforme, d'environ 70 µm de diamètre ; sur une coupe, les ascomes apparaissent ellipsoïdaux ou un peu ovoïdes, de 200-300 × 140-200 µm, presque complètement enfoncés dans le thalle de l'hôte qui n'est pas modifié (pas de taches ni de mycocécidies visibles).

Excipulum de 18-25 µm d'épaisseur, à peine plus épais dans la région ostiolaire, pseudoparenchymateux, constitué de deux couches :

- L'externe pigmentée de brun clair chez les ascomes jeunes, de brun sombre chez les ascomes matures, à cellules isodiamétriques dans le plan tangentiel (*textura angularis*), mais allongées dans le plan vertical (lumière de 8,5-11,5 × 3,5-6 µm) ;
- L'interne incolore, à cellules plus arrondies que celles de la couche externe, de 4-10 × 5-9 µm.

Hamathécium constitué par des filaments interascaux (fig. 4) épais (4-8 µm), disparaissant pendant ou avant la maturité des asques, (**paraphyses** selon Hafellner, 1989) et par des **périphyses** atteignant 20 × 1,5-3 µm, plus ou moins ramifiées, abondantes dans l'ensemble du canal ostiolaire.

Hyménium incolore, I -, avec d'abondantes guttules.

Asques (fig. 4) claviformes-cylindriques, de 75-80 × 12-15 µm, à paroi mince y compris au sommet (asques unituniqués), octosporés, à épiplasme I + (rougeâtre).

Spores (fig. 5) subunisériées, incolores, largement ellipsoïdales, de (12)13,5-*15,3*-17(18) × (7,5)8,5-8,8-9,5 µm (47 spores mesurées), à rapport longueur sur largeur de (1,3)1,5-*1,8*-2(2,3), à une cloison transversale, à cellules égales ou presque, un peu rétrécies au niveau de la cloison, à surface lisse.

Mycélium formé d'hyphes en relation avec la base des périthèces, incolores ou brun pâle au contact des ascomes, peu visibles.

Remarques : On connaît seulement deux espèces de *Lichenochora* parasites de Teloschistales : *L. constrictella* (Müll. Arg.) Haf. (Hafellner, 1989), à spores par 4, de 20-25 × 8-10 µm, sur *Fulgensia bracteata* (Hoffm.) Räs., et *L. xanthoriae* sur *Xanthoria elegans*. Les spécimens étudiés sont conformes à la description originale de *L. xanthoriae*, à l'exception d'un détail : Triebel et al. (1991) indiquent que *L. xanthoriae* induit de petites cécidies sur le thalle de *Xanthoria elegans*. Cependant le thalle de *Caloplaca proteus* étant en grande partie granuleux, de telles cécidies, si elles existent, ne peuvent y être observées.

Répartition géographique et habitat : *Lichenochora xanthoriae* n'était jusqu'ici connu que par le type, sur *Xanthoria elegans*, en Amérique du Nord (USA, Utah). Ce *Lichenochora* est donc mentionné pour la première fois en Europe et sur un nouvel hôte, *Caloplaca proteus*.

Spécimens examinés

- Autriche, Tyrol, Stubaier Alpen, Serles-Gruppe, im Gschnitztal bei St. Magdalena : knapp unterhalb der Kirche bei 1660 m, W-exponierte Stirnfläche eines von einer Fichte leicht beschatteten Dolomitfelsens,

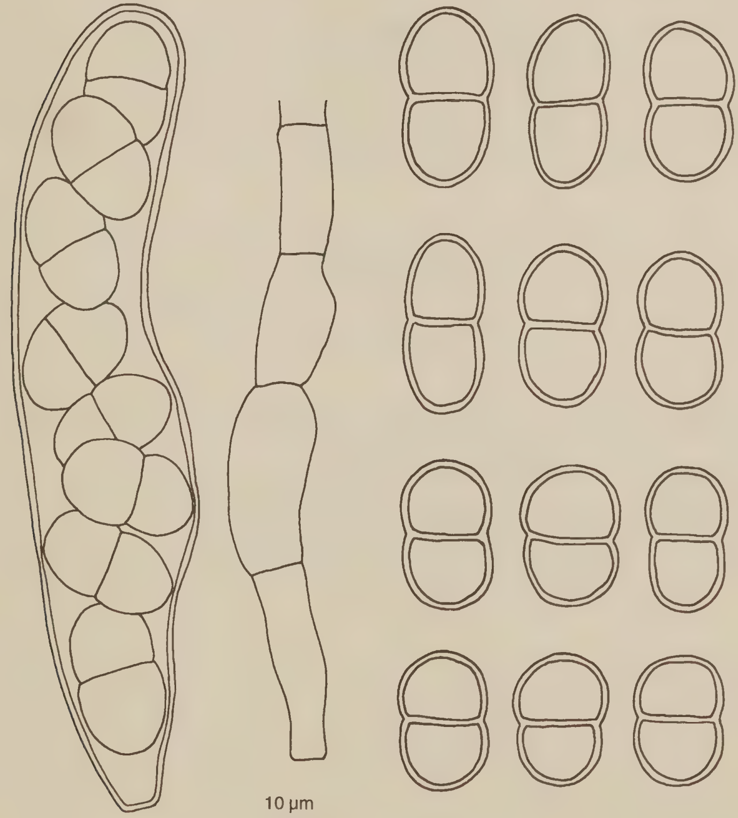

Fig. 4 — Asque et fragment de fragment de filament interascal (paraphyse) de *Lichenochora xanthoriae* (observés dans l'eau).
Fig. 5 — Variabilité de la forme des spores de *Lichenochora xanthoriae* (observées dans l'eau).

1976/06/31. Leg. M. Steiner, GZU et MARSSJ (Hertel, Lich. Alpium, n° 349 : topotype de *Verrucaria protearia*).

• Comme le précédent, mais : Unterhalb St. Magdalena bei Gschnitz, alt. c. 1600 m, 1973/09/29. Leg. M. Steiner, GZU et M (Plantae Graec. Lich., n° 114 : isotypes de *Verrucaria protearia*).

Remerciements

Nous remercions bien chaleureusement A. Bellemère (Saint-Cloud), G. Clauzade (Cavaillon) et A. Triebel (München) qui ont relu et analysé d'une manière critique notre manuscrit. Nous sommes également redevables au conservateur de l'herbier de l'Institut de botanique de Graz (GZU) pour le prêt des spécimens étudiés.

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BELLEMERELLA TRAPELIAE GEN. ET SP. NOV., ASCOMYCÈTE LICHÉNICOLE NON LICHÉNISÉ (VERRUCARIALES, VERRUCARIACEAE)

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Resumé

Bellemerella trapeliae Nav.–Ros. et Roux gen. et sp. nov., ascomycète vivant en parasymbiose avec *Trapelia involuta* (Tayl.) Hertel, diffère du genre *Muellerella* principalement par des ascomes à sommet ombiliqué, une paroi ascomale formée de deux couches très distinctes par leur structure et des pseudoparaphyses du type *a* (à une cellule basale arrondie et 1–3 cellules distales allongées et étroites).

Abstract

Bellemerella trapeliae Nav.–Ros. et Roux gen. et sp. nov., a parasymbiontic ascomycete on *Trapelia involuta* (Tayl.) Hertel, differs from the genus *Muellerella* mainly in the umbilicate apical part of the ascoma, an ascomatal wall whith two distinctly structured layers and *a*–type pseudoparaphysis (with 1 basal roundish cell and 1–3 apical elongated cells).

Resumen

Bellemerella trapeliae Nav.–Ros. et Roux gen. et sp. nov., ascomicete parasimbionte de *Trapelia involuta* (Tayl.) Hertel, se diferencia del género *Muellerella* principalmente por sus ascomas umbilicados en la parte superior, la pared del ascoma formada por dos capas bién diferenciadas en estructura, pseudoparáfisis del tipo *a* (con una célula basal redondeada y 1–3 células apicales alargadas y estrechas).

Resumo

Bellemerella trapeliae Nav.–Ros. et Roux gen. et sp. nov., askomiceto parasimbioza al *Trapelia involuta* (Tayl.) Hertel, diferencas de la genro *Muellerella* precipe pro askujoj kun umbilikohava supro, askuja parieto konsistanta el du tavoloj laŭstrukture tre diferencaj kaj pseŭdoparafizoj de la tipo *a* (kun unu bazĉelo ronda kaj 1–3 apeksaj ĉeloj longformaj k maldikaj).

Introduction

Lors de l'examen de l'herbier de G. Clauzade (MARSSJ), nous avons observé, sur le thalle de *Trapelia involuta* (Tayl.) Hertel, un champignon lichénicole non lichénisé, bien caractérisé par des ascomes périthécioïdes à sillons radiaires et des asques polysporés, dont nous n'avons pas trouvé trace dans la littérature, notamment dans Clauzade et Roux (1976), Clauzade et al. (1989), Keissler (1930), Triebel (1989) et Vouaux (1912–1914).

Après une étude approfondie de cette espèce et sa comparaison avec les genres voisins, nous sommes arrivés à la conclusion qu'elle constituait une espèce et un genre nouveaux : *Bellemerella trapeliae* Nav.–Ros. et Roux gen. et sp. nov. Nous dédions ce genre à notre ami, l'éminent lichénologue et mycologue français, André Bellemère.

Matériel et méthodes

Les coupes microscopiques ont été réalisées à main levée et observées dans l'eau, le lugol (I), une solution aqueuse d'hydroxyde de potassium à 10% (K) et le bleu au lactophénol (bleu coton dans le lactophénol), avec un microscope photonique (grandissement maximal de × 1500).

Nous avons observé seulement du matériel d'herbier, mort. Les dessins ont tous été réalisés avec l'aide d'un tube à dessin.

Dans l'expression des dimensions des spores, la moyenne est indiquée en italique, encadrée par les valeurs extrêmes après élimination des 10% des valeurs les plus élevées et des 10% des valeurs les plus faibles, tandis que les valeurs extrêmes absolues sont placées entre parenthèses.

Dans la description, notamment celle de l'hamathécium, nous utilisons la nomenclature de Roux et Triebel (1994).

Diagnose du genre et de l'espèce

Bellemerella trapeliae Nav.–Ros. et Roux gen. et sp. nov.

Fungus lichenicola non lichenisatus ad familiam Verrucariaceae Zenker (Ascomycetes, Verrucariales) pertinens. Ascomata perithecioidea, dispersa, globosa (c. 0,15 mm diam.), adnata, atra, leviter rugosa, in summa parte, proxime ostiolo, umbilicata; ostiolum depressum. Paries ascomatis in sectione transversalis 20–30 µm crassus, a duo stratis constitutis: stratus externus nigrobrunneus, pseudoparenchymaticus, cellulis rotundatae, parietes incrassatae, instructus, et stratus internus incoloratus, pseudoparenchymaticus vel prosoplectenchymaticus, a cellulis elongatae, parietes non incrasatae, instructus. Hamathecium e brevis periphysibus (5–8× 1–2 µm), 2–4 cellulis constitutis, atque pseudoparaphysibus (10–17 µm longis), ad basaliter cellula rotunda (2,5–3 µm crassa) et apicaliter 1–3 cellulis elongatis (1–1,5 µm crassis), compositum. Asci elongato clavati vel subcylindrici, (35)50–55× 9–11 µm, bitunicati, apicalibus incrassatis, tholo oculare camera destitutus, polysporatis. Gelatina hymenialis gelatina abunda, iodo aurantiaco–rubescens. Ascosporae elongato–oblongae vel subcylindricae, (5,5)6–*6,9*–8(10) x 1,5–*1,6*–1,7(1,9) µm, rectae vel leviter curvatae, (0)1–septatae, ad septum non constrictae, primum incoloratae, deinde pallide brunneae.

Type : France, Haute–Loire, Saint–Didier–d'Allier, Rochegrand, alt. 900 m, sous *Pinus sylvestris.* 1954/09/08. Leg. G. Clauzade, MARSSJ.
Hôte–type : *Trapelia involuta* (Tayl.) Hertel

Description

Ascomes (fig. 1) perithécioïdes (pseudothèces), presque entièrement saillants, globuleux, d'environ 150 µm de diamètre, noirs, à surface un peu rugueuse, à sommet ombiliqué autour de l'ostiole, localisés sur le bord des squamules de l'hôte [*Trapelia involuta* (Tayl.) Hertel], qui ne semble pas altéré (parasymbiose). Paroi ascomale (excipulum) de 20–30 µm d'épaisseur, formée (fig. 2–5) de 8 à 10 assises cellulaires, constituée de deux couches distinctes, l'externe brun sombre, pseudoparenchymateuse (= paraplectenchymateuse), l'interne incolore, à structure pseudoparenchymateuse à la périphérie, mais devenant prosoplectenchymateuse vers l'intérieur. Cellules de la couche externe [lumen de (2,5)4–8,5 x (2)2,5–4,5(6,5) µm; paroi de 1–3,5 µm d'épaisseur] plus grandes et à paroi plus épaisse que celles de la couche interne [lumen de (2)4–7(8) x (1)1,5–2,5(3); paroi de 0,5–1 µm]; paroi cellulaire pigmentée de brun (pas de granules pigmentaires visibles en microscopie photonique) ou incolore. Pas d'appendices hyphoïdes.

Des primordiums d'ascomes sont parfois observés (fig. 4) à proximité immédiate de la base d'ascomes matures, auxquels ils sont reliés par des hyphes courtes.

Hyménium (fig. 2–3 et 7) constitué par une abondante gelée dans laquelle s'observent des asques et des restes de longs filaments interascaux évanescents, correspondant vraisemblablement à des paraphyses.

Suprahyménium (fig. 2 et 5–6) formé de cellules incolores, arrondies, non ou peu allongées [2–3(4) × 1,5–2,5 µm], à paroi très mince (ne dépassant pas 0,5 µm).

Subhyménium (fig. 2–3) incolore, de 5–10 µm d'épaisseur, formé de cellules [(3)4–7,5 × (1)2–3(4) µm] incolores, allongées, non anguleuses, plus arrondies à la partie supérieure, à paroi très mince (moins de 0,5 µm). La partie supérieure du subhyménium est en grande partie formée de cellules ascogènes.

Périphyses (fig. 5) peu visibles, courtes, de 5–8 × 1–2 µm, formées de 2–4 cellules; les périphyses de la formation externe à sommet renflé et pigmenté de brun, celles de la formation interne entièrement incolores.

Pseudoparaphyses (fig. 5–6) peu visibles, de 10–17 µm de longueur, nombreuses, incolores, formées d'une cellule basale arrondie (2,5–3 µm de largeur) et de 1–3 cellules distales allongées et étroites (1–1,5 µm de largeur). Ces pseudoparaphyses courtes correspondent au type *a* de ROUX et TRIEBEL (1994).

Asques (fig. 7) claviformes allongés ou subcylindriques, de (35)50–55 × 9–11 µm, peu distinctement pédonculés, bituniqués, à paroi un peu épaissie au sommet en un tholus peu visible, apparamment dépourvus de chambre oculaire, multisporés (spores par 32–64). Déhiscence non observée.

Ascospores (fig. 8) restant longtemps incolores, mais devenant brun clair à la fin, simples ou en majorité uniseptées, de (5,5)6–*6,9*–8(10) x 1,5–*1,6*–1,7(1,9) µm (d'après 52 mesures), oblongues allongées ou subcylindriques, souvent un peu courbes à la fin, environ 4 fois plus longues que larges [rapport longueur sur largeur = (3,1)3,6–*4,2*–4,8(6)], à extrémités arrondies, à paroi très mince (moins de 0,5 µm), dépourvue de halo, lisse.

Conidiomes non observés.

Hyphes végétatives (fig. 9) peu visibles, en relation avec la base des ascomes, incolores ou à peine brunâtres à proximité des ascomes, de 2,5–3,5 µm de diamètre (y compris la paroi d'environ 0,5 µm d'épaisseur).

Réactions au lugol (I) : toutes les parties sont I –, sauf la gelée hyméniale et l'épiplasme nettement I + (rouge orangé).

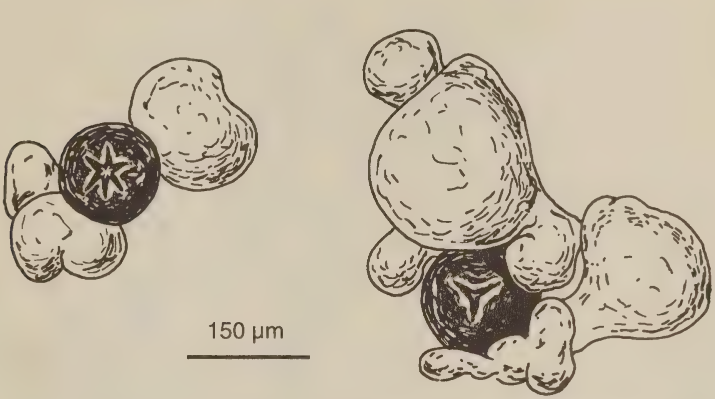

Fig. 1 — *Bellemerella trapeliae*: deux ascomes sur les squamules verruqueuses de *Trapelia involuta.*

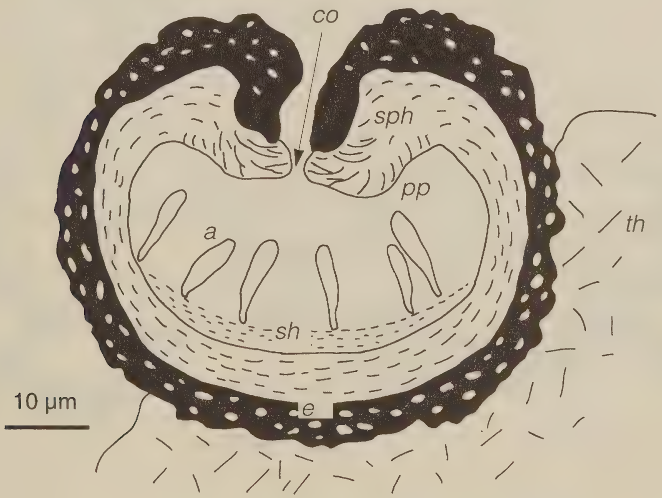

Fig. 2 — Structure de l'ascome de *Bellemerella trapeliae* d'après une coupe verticale radiale montée dans l'eau (semi-schématique). a : asques ; co : canal ostiolaire, avec périphyses ; e : excipulum (couche externe pigmentée, couche interne incolore ou presque) ; pp ; pseudoparaphyses courtes; sh : subhyménium ; sph : suprahyménium ; th : thalle de l'hôte.

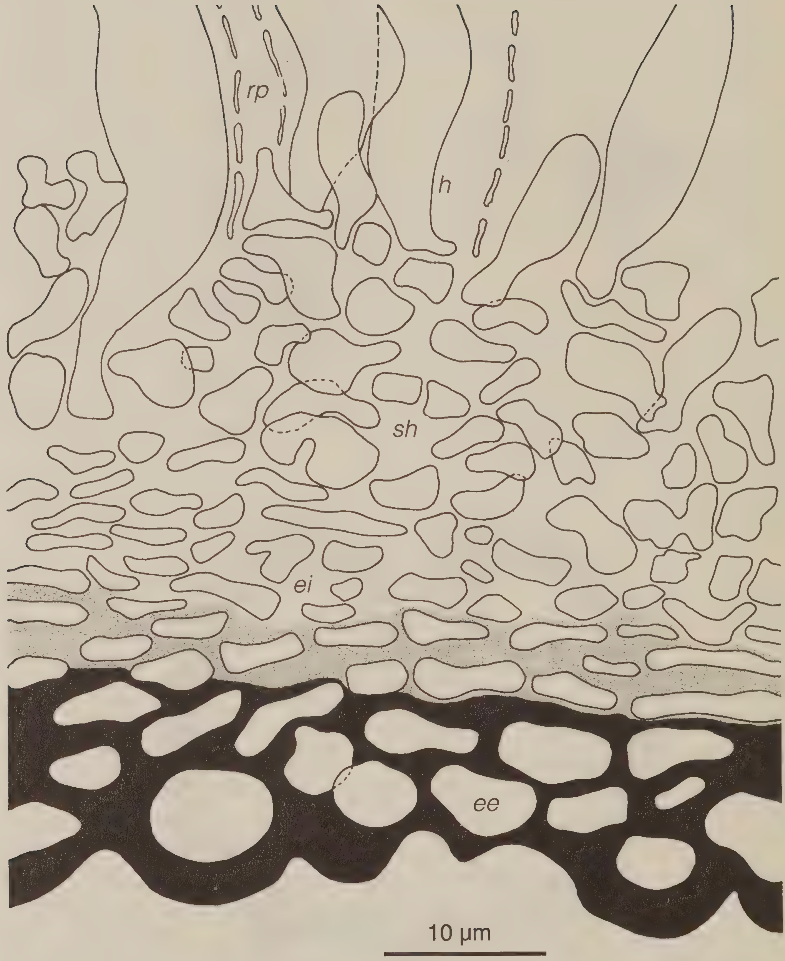

Fig. 3 — Détail de la partie inférieure de l'ascome de *Bellemerella trapeliae* d'après une coupe verticale radiale montée dans le bleu au lactophénol. ee : couche externe de l'excipulum (fortement pigmentée) ; ei : couche interne de l'excipulum (non ou à peine pigmentée) ; rp : restes de filaments interascaux (vraisemblablement paraphyses) ; sh : subhyménium (non pigmenté) ; h : hyménium montrant divers stades de l'ascogenèse.

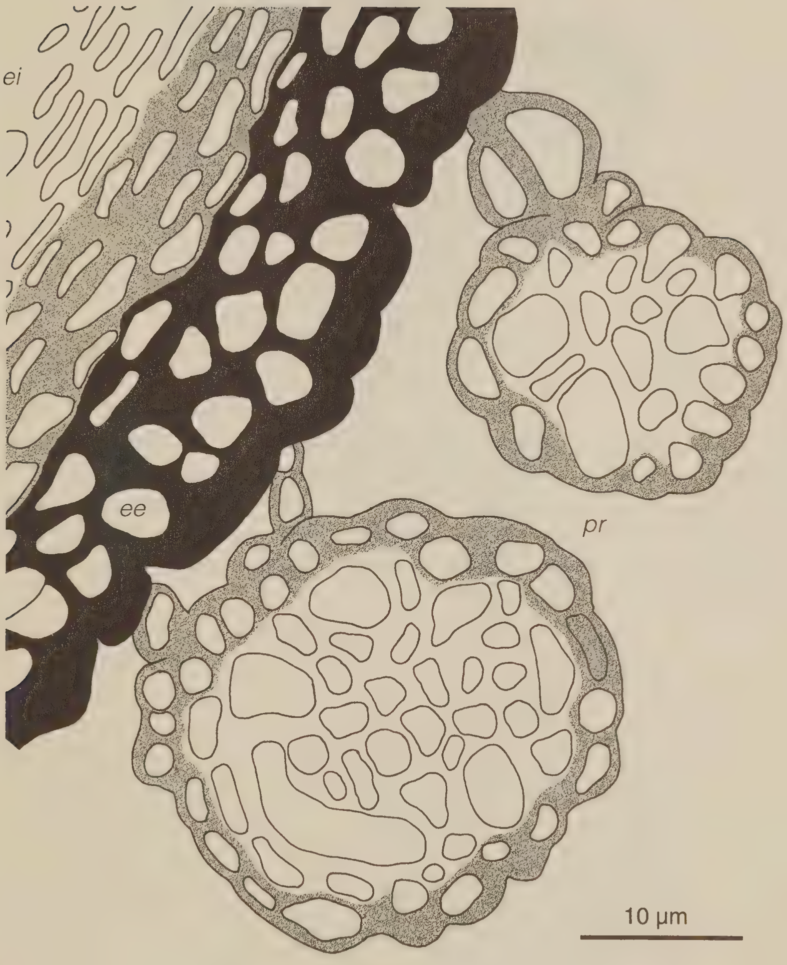

Fig. 4 — Détail de la partie latérale inférieure d'une coupe d'ascome de *Bellemerella trapeliae,* portant deux primordiums d'ascomes, d'après une coupe verticale radiale montée dans le bleu au lactophénol. ee : couche externe de l'excipulum (fortement pigmentée) ; ei : couche interne de l'excipulum (non ou à peine pigmentée) ; pr : primordium d'ascome.

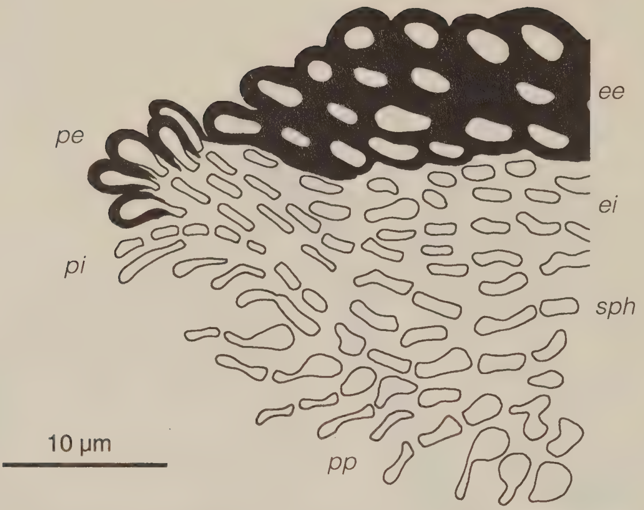

Fig. 5 — Détail de la partie supérieure de l'ascome de *Bellemerella trapeliae* d'après une coupe verticale radiale montée dans le bleu au lactophénol. Excipulum (à cellules plus petites que celles de la base de l'excipulum) : ee : couche externe ; ei : couche interne ; pp : pseudoparaphyses courtes ; pe : périphyses de la formation externe ; pi : périphyses de la formation interne ; sph : suprahyménium.

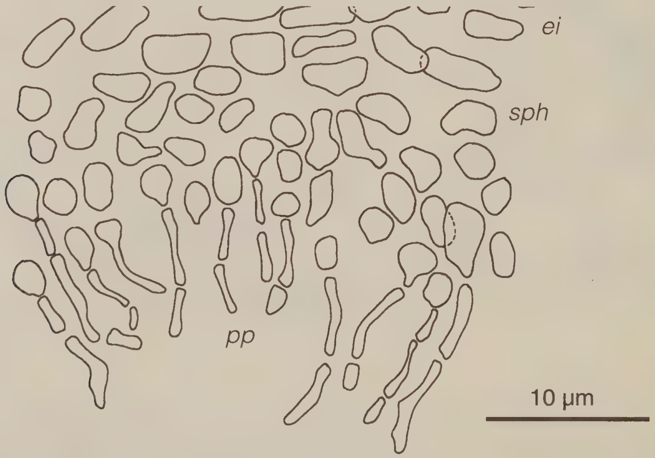

Fig. 6 — Détail des pseudoparaphyses courtes (pp) de *Bellemerella trapeliae*, issues du suprahyménium (sph), d'après une coupe d'ascome (verticale, passant à proximité immédiate de l'ostiole) montée dans le bleu au lactophénol. ei : couche interne, non pigmentée, de l'excipulum.

fig. 7

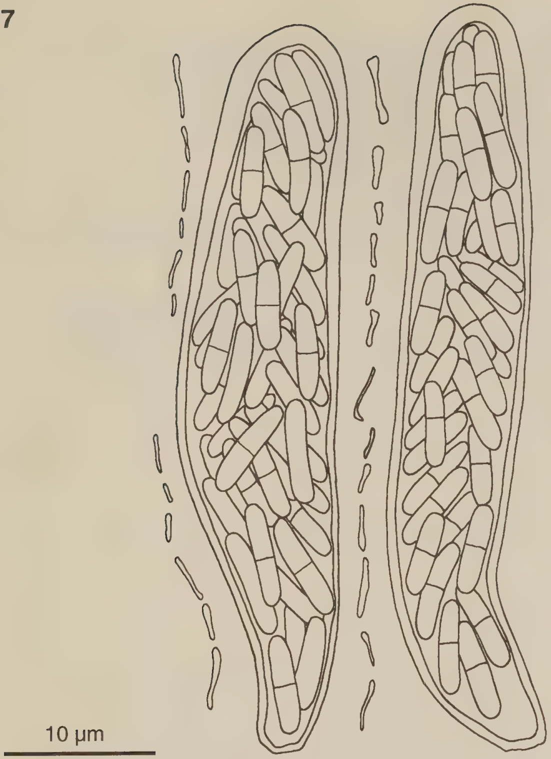

fig. 8

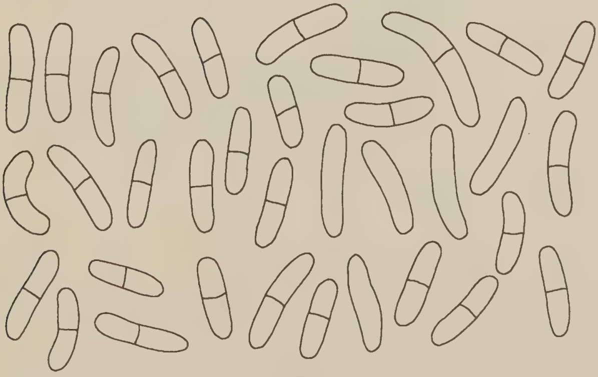

Fig. 7 — Asques polysporés et restes de longs filaments interascaux (vraisemblablement paraphyses) de *Bellemerella trapeliae*, d'après un écrasement d'ascome coloré par le bleu au lactophénol.
Fig. 8 — Ascospores de *Bellemerella trapeliae*, observées dans l'eau.

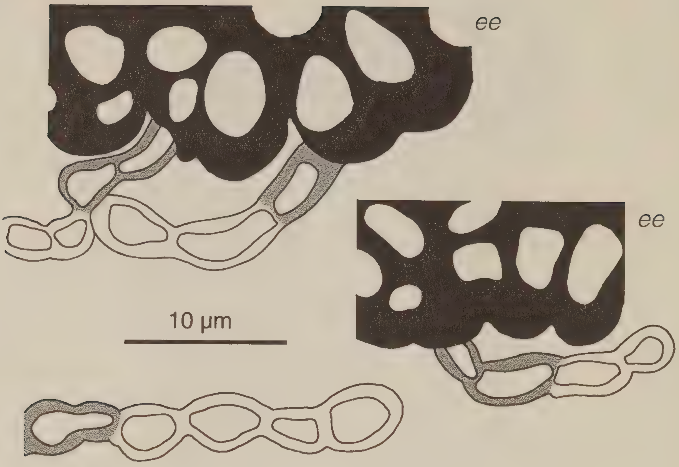

Fig. 9 — Hyphes végétatives de *Bellemerella trapeliae* observées dans l'eau. ee : couche externe de l'excipulum.

Affinités et position systématique

Parmi les champignons lichénicoles non lichénisés à ascomes périthécioïdes, deux genres avec des asques à nombreuses spores brunes ont été jusqu'ici acceptés :

Rosellinula R. Sant., classé dans les Dothideales (Eriksson et Hawksworth, 1993), s'éloigne considérablement de *Bellemerella*, notamment (Matzer et Hafellner, 1990) par des ascomes présentant un abondant réseau de paraphysoïdes et par des asques à gélin I+ (bleu).

Muellerella Hepp ex Müll. Arg. [d'après l'étude du type du genre, *M. polyspora* Hepp ex Müll. Arg., de *M. hospitans* Stiz. et de *M. lichenicola* (Sommerf.) D. Hawksw.], au contraire, présente des affinités certaines avec *Bellemerella*, notamment par des ascomes (fig. 10) à pseudoparaphyses courtes et un hyménium contenant une abondante gelée I+ (rouge orangé). Mais *Muellerella* (fig. 10 et 11, tab. 1) diffère nettement de *Bellemerella* par les caractères suivants :

– Paroi ascomale à structure uniforme, même si sa partie externe est pigmentée tandis que l'interne est incolore.

– Sommet des ascomes conique ou aplati, à ostiole non déprimé.

– Pseudoparaphyses courtes du type *b* (Roux et Triebel, 1994) .

– Absence de restes de longs filaments interascaux évanescents.

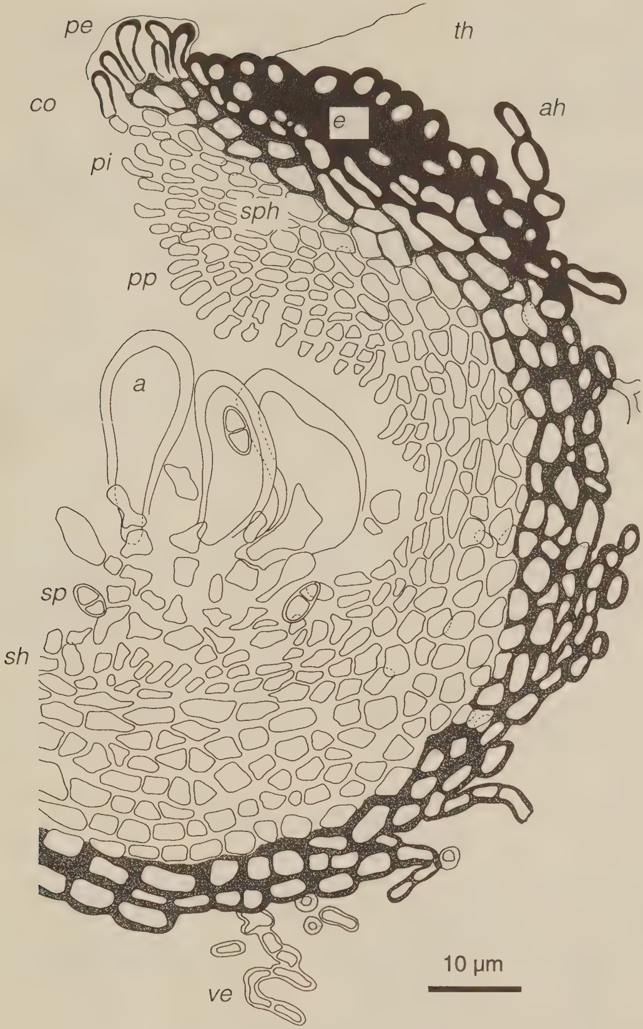

Fig. 10 — Structure de l'ascome de *Muellerella lichenicola* d'après une coupe verticale radiale montée dans le bleu au lactophénol. a : asque ; ah : appendice hyphoïde ; co : canal ostiolaire ; e : excipulum (à partie externe pigmentée et partie interne non pigmentée) ; pe : périphyses de la formation externe ; pi : périphyses de la formation interne ; pp ; pseudoparaphyses courtes (du type b) ; sh : subhyménium ; sp : spores ; sph : suprahyménium ; ve : hyphes végétatives (Gordes, sur apothécies de *Caloplaca* sp. ; MARSSJ).

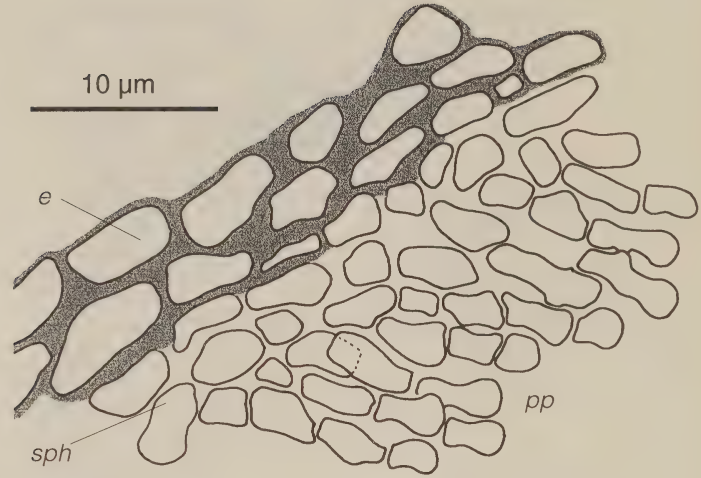

Fig. 11 — Structure des pseudoparaphyses de *Muellerella polyspora* d'après une coupe verticale radiale d'ascome montée dans le bleu au lactophénol. e : partie interne et supérieure de l'excipulum ; pp ; pseudoparaphyses courtes (du type b) ; sph : suprahyménium (G, holotype).

	Bellemerella	*Muellerella*	*Plurisperma* *
Subiculum	absent	absent	présent
Excipulum	formé de deux couches distinctes par leur structure	à structure uniforme	à structure uniforme
Ostiole	déprimé	plat ou un peu saillant	en forme de papille
Pseudoparaphyses	présentes, du type a	présentes, du type b	présentes, de type non précisé
Filaments interascaux longs (paraphyses ?)	présents, mais évanescents	absents	absents
Biologie	lichénicole	lichénicole ou hépathicole	saprophyte

* Fide MATZER, 1993.

Tab. 1 — Principaux caractères distinctifs des genres *Bellemerella, Muellerella* et *Plurisperma.*

Plurisperma Sivenesan, non lichénicole, autrefois inclu dans *Muellerella* (TRIEBEL, 1989; ARX et MÜLLER, 1975), en a été exclu par MATZER (1993), notamment parce qu'il présente un subiculum bien distinct, un excipulum non épaissi au sommet, un ostiole très saillant, en forme de papille, et à cause de son caractère saprophytique.

Bellemerella est donc un genre voisin mais distinct de *Muellerella* et de *Plurisperma*, et doit être, comme ces derniers, placé dans la famille des Verrucariaceae.

Spécimens examinés

Outre le matériel original de *Bellemerella trapeliae*, nous avons examiné, à fin de comparaison, les spécimens suivants:

- ***Muellerella hospitans* Stiz.**

France, Provence, Vaucluse, Monieux, la Jaille (apud Javon), sur tre malglata ŝelo de la bazo de trunko de *Quercus pubescens*. Alt. 770 m. 1989/05/03. Leg. G. Clauzade, O. Bricaud k C. Roux, herb. C. Roux, MARSSJ n° 20521. En la apotecioj de *Bacidia rubella*.

- ***Muellerella lichenicola* (Sommerf.: Fr.) D. Hawksw.**

France, Provence, Vaucluse, Gordes, col de Gordes, 350 m. 1993/06/10. Leg. G. Clauzade, P. Navarro–Rosinés et C. Roux (MARSSJ). Sur apothécies de *Caloplaca* sp.

- ***Muellerella polyspora* Hepp ex Müll. Arg.**

Suisse, Auf *Carpinus* [...] Saconnex. 1860/10/03. Leg. P. Hepp 1083 (G, holotypus). Sur un thalle crustacé endophléode, stérile, à *Trentepohlia*.

Remerciements

Nous remercions bien chaleureusement G. CLAUZADE (Cavaillon), P. DIEDERICH (Luxembourg) et D. TRIEBEL (München), qui ont revu notre manuscrit, ainsi que P. CLERC (Genève), qui a recherché le matériel type de *Muellerella polyspora*.

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THREE NEW SPECIES OF OPEGRAPHACEAE (LICHENS) FROM THE NAMIB DESERT

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Abstract.- **Bactrospora namibiensis**, **Lecanographa longicarpa** and **L. tehleri** are described as new from coastal localities of the Namib desert (SW Africa).

INTRODUCTION

The Namib desert is a narrow belt of desert of more than 2000 km along the coast of SW Africa (Namibia) between the Olifants river (South Africa) in the south and the Carunjamba river (Angola). It is one of the most arid parts of the world as virtually the entire area receives less than 100 mm of rain per year, but the coastal fringe experiences fog on more than 120 days per year, the fog being extremely rich in salt (c. 120 kg/ha/year according to Goudie 1972). Such a persistent and regular mist permits a rich and luxuriant, and adaptively interesting, lichen development, as in similar areas elsewhere in the world (Rundel 1978). One of the best examples of the exuberant lichen vegetation is the so-called "lichen fields" on the gravel and sandy flats near the sea north of Swakopmund, which are dominated by the cushions of **Teloschistes capensis** (L.f.) Vainio ex Müll. Arg. and **T. puber** (Ach.) Almborn; the ground cover of these fruticose dominated lichen fields can exceed 70% and their biomass can reach 400 mg/m^2 (Schieferstein & Loris 1992). Jürgens & Niebel-Lohmann (1995) provide detailed information on the structure and ecology of two extraordinary lichen fields in the Southern Namib (near Lüderitz and near Alexanderbay).

Although not very rich in species, the Namib desert hosts several interesting growth forms and endemic taxa. Several examples are listed below:

- the genus **Caloplaca** Th. Fr. has numerous species in the desert, with the subfruticose endemic **C. eudoxa** (Müll. Arg.) Zahlbr. (Poelt & Pelleter 1984) and the spectacular **C. elegantissima** (Nyl.) Zahlbr. and its isidiate relative **C. namibensis** Kärnefelt (Kärnefelt 1988), the former being reported from Namibia and the Atacama desert in Peru and the latter being a Namibian endemic (Kärnefelt 1990);
- the monotypic, subfruticose and endemic genus **Coronoplectrum** Brusse (Brusse 1987);
- the genus **Neofuscelia** Essl. has several endemic species in the Namib desert: **N. follmannii** Krug, **N. incomposita** (Essl.) Essl., **N. lagunebergensis** Krug, **N. namaënsis** (J. Stein & Zahlbr.) Essl. and **N. tentaculina** (Essl.) Essl. (Esslinger 1977; Krug & Sang 1995);
- the fruticose and endemic genus **Santessonia** Hale & Vobis, with three species which develop a lacunose cortical layer for the interception of fog (Hale & Vobis 1978; Sérusiaux & Wessels 1984; Follmann 1987);
- the genus **Teloschistes** Norman is represented by three species: **T. capensis** and **T. puber** which are very abundant but restricted to the coastal areas of the Namib desert, the Karoo and the North Western Cape province in South Africa, and by **T.**

chrysocarpoides Vainio, a rare, epiphytic species of the Namib desert (Almborn 1989);
- the monotypic genus **Xanthodactylon** P. Duvigneaud, abundant along the coasts of the Namib down to the Cape area in South Africa (Kärnefelt 1989);
- the spectacular genus **Xanthomaculina** Hale, with the terricolous and free-growing endemic **X. convoluta** (Hue) Hale and the south African endemic **X. hottentota** (Ach.) Hale (Hale 1985).

This paper is a modest contribution to the knowledge of the lichen flora of the Namib desert and deals with the Opegraphaceae collected there by two of us (E. S. & D. W.) during a joint field trip in 1983. Besides the three species described as new below, the recently described **Lecanographa subcaesioides** Egea & Torrente (Egea & Torrente 1994) has also been found. It is known from Uruguay and from Namibia.

METHODS

Sections of thalli and ascomata were mounted in water, a 10 % KOH solution (K), Lugol's solution (I) and lactophenol cotton-blue (LCB). All measurements indicated were made in water. The iodine reaction of the asci was studied in Lugol's solution after pretreatment with K (K/I). Thin layer chromatography (TLC) of acetone exctracts of thalli was carried out following the standard systems (e.g. White & James 1985).

Bactrospora namibiensis Egea, Sérusiaux, Torrente & Wessels sp. nov. (Fig. 1 A-E)

Thallus endophloeodes. Ascomata nigra, dispersa, rotundata vel leviter irregularia, 0.4-1.2 mm lata, primum subimmersa, demum adnata. Excipulum dimidiatum, in parte laterali usque 125 µm crassum. Paraphysoides ad 2 µm crassae, apicem versus leviter incrassatae, ramoso-connexae. Asci 180-240 x 8-10 µm. Ascosporae a typo '*Dryina* ' dicto. Pycnidia non visa.

Typus: Namibia, Skeleton Coast Park, 11 km N of the Outpost at Ugabmond following the coastal road, near a marble ridge orientated E-W, on dead wood lying on the beach, 2.1983, E. Sérusiaux 5299 & D. Wessels (LG-holotypus).

Thallus endophloeodal; photobiont: a species of Trentepohliaceae. Ascomata apothecioid, black, scattered, subimmersed to adnate, roundish or somewhat irregular in outline, 0.4-1.2 mm across, slightly pruinose, plane or slightly concave with a shallow margin, becoming +/- convex and immarginate. Excipulum well-developed, laterally dark brown, composed of conglutinate, thick-walled hyphae, up to 125 µm thick, open at the bottom, I-, K/I-. Hymenium colourless, 200-300 µm thick, I-, K/I-. Subhymenium greyish, 50-80 µm thick, I-, K/I-. Paraphysoids dichotomously branched, with few or no anastomoses and loosely interlaced in the hymenium, up to 2 µm wide. Apical cells of paraphysoids strongly branched and anastomosing, forming a reticulate dark brown epithecium. Asci fissitunicate, 180-240 x 8-10 µm, cylindrical with a foot-like base not or slightly widened, easily separated from ascogenous hyphae and often broken, appearing multispored; exoascus and endoascus not amyloid or hemiamyloid. Ascospores acicular when young, but soon fragmenting within the ascus into unicellular or paucicellular segments (*Dryina*-type, Egea & Torrente 1993); each cell cylindrical, 3-5 µm in length and 2-2.5(-3) µm in diam.
Pycnidia not seen.

Chemistry: Thallus and medulla K-, C-, KC-, P-. No lichen substances detected by TLC.

Distribution and habitat: **Bactrospora namibiensis** is known only from the type locality at the southern edge of the Skeleton Coast Park in Namibia. It was abundant on dead wood lying on the beach. This locality also hosts an exuberant population of **Santessonia namibensis** Hale & Vobis (Sérusiaux & Wessels 1984).

Notes: On account of its non-hemiamyloid asci, the inclusion of this new taxon in **Bactrospora** Massal. is somewhat doubtful, but no other described genus is available for it. This taxon is easily distinguished from other species of that genus with *Dryina*

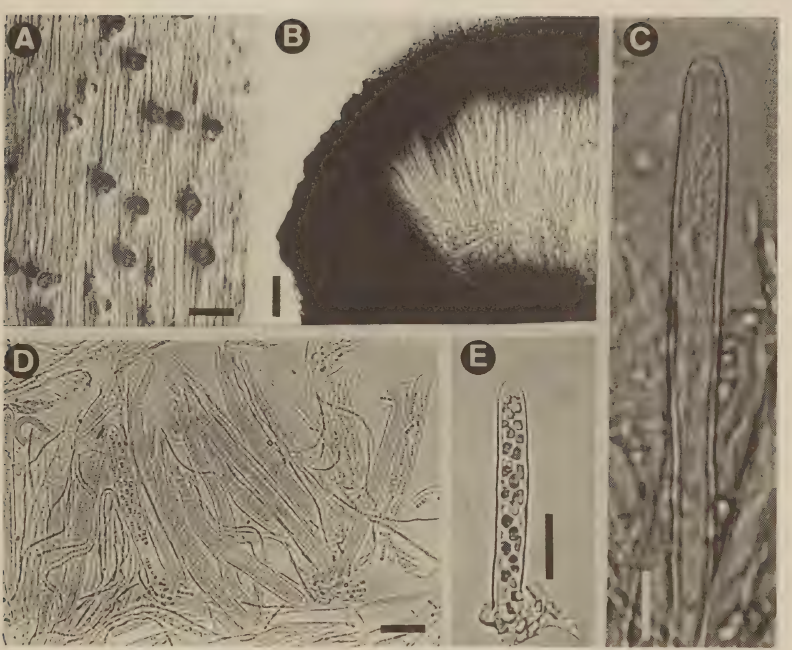

Figure 1. **Bactrospora namibiensis** (holotype). A, Habit. B, Vertical section of an ascoma. C, Ascus. D, Hymenium after squash. E, Broken ascus. (C-E mounted in K/I). Scales: A = 2 mm; B = 50 μm; C = 10 μm; D-E = 20 μm.

-type ascospores (see fig. 2 in Egea & Torrente 1993:214) by its very long, cylindrical asci: the other three species with that type of ascospores always have asci less than 150 µm long. Since the monograph of the genus published by two of us (Egea & Torrente 1993), Henssen & Thor (1994) have recognized the genus level for the species with ascospores of the *Homalotropa* - and *Jenikii* -type and have adopted **Melampylidium** Stirt. ex Müll. Arg. for that group.

Lecanographa longicarpa Egea, Sérusiaux, Torrente & Wessels sp. nov. (Fig. 2 A-D)

Thallus crustaceus, albus vel griseoalbus, ecorticatus. Ascomata lirellata (0.5-1.9 x 0.2-0.3 mm), adnata. Discus pruinosus. Paraphysoides ramosae et anastomosantes, usque ad 2 µm crassae. Asci fissitunicati, 62-70 x 17-20 µm. Ascosporae fusiformes, 25-29 x 5.5-6.5 µm, 7-septatae, halonatae, primum incoloratae, deinde brunneae. Pycnidia subimmersa. Conidia recta, 5-7 x 1 µm.

Typus: Namibia, Laguneberg Range (N part), N of Myl 72, basalt hill facing the sea, alt. c. 200 m, on twigs of a small shrub, 2.1983, E. Sérusiaux 5186 & D. Wessels (LG-holotypus).

Thallus crustose, corticolous, white to white-grey, cracked, with a smooth or somewhat farinose surface, delimited by a thin, black prothallus, up to 125 µm in section, ecorticate; medulla white with many crystals of unknown nature (insoluble in K) incorporated between the hyphae. Photobiont: a species of Trentepohliaceae.
Ascomata lirelliform, often branched, 0.5-1.9 x 0.2-0.3 mm, adnate, scattered or crowded, with a conspicuous margin, scarcely or not raised above the level of the disc, covered by a dense coating of white pruina; disc plane. Excipulum well developed, dark brown, K+ dark green. Hymenium hyaline, 80 µm thick, I+ reddish. Subhymenium pale brown, 30 µm thick. Paraphysoids up to 1.5 µm wide, branched and anastomosing, not or slightly widened and with slightly pigmented walls at the apices. Asci of the *Grumulosa* -type (Torrente & Egea 1989), 62-70 x 17-20 µm at maturity, with a distinct ring structure.

Ascospores 25-29 x 5.5-6.5 µm, 7-septate, fusiform, surrounded by a thick gelatinous sheath, hyaline but turning brown when old; cell walls thin, not or slightly widened at level of the septa. Pycnidia subimmersed, secondarily multilocular. Conidia 5-7 x 1 µm, straight or slightly curved.

Chemistry: Thallus K-, C-, P-; confluentic acid detected by TLC.

Distribution and habitat: **Lecanographa longicarpa** is known only from the type locality, a low basalt hill near the sea in the Namib desert, where it grows on twigs of small shrubs. The shrubs in this locality have a luxuriant lichen flora with **Trichoramalina melanothrix** (Laur.) Rundel & Bowler, **Xanthodactylon flammeum** (L. f.) Dodge, **Xanthoria turbinata** Vainio, and many, still unidentified species (incl. a **Ramalina** and an **Usnea** species). **Santessonia lagunebergii** Sérusiaux & Wessels, **S. hereroensis** (Vainio) Follm. (= **S. sorediata** Sérusiaux & Wessels) and **Xanthomaculina hottentota** are abundant on rocks and pebbles of the desert pavement in the same locality.

Notes: The 7-septate ascospores surrounded by a thick gelatinous sheath, and the C-negative thallus suggest a close relationship to **Lecanographa subcaesioides** Egea & Torrente, known from Uruguay and the Namib desert, and to **L. dialeuca** (Cromb.) Egea & Torrente, known from coastal areas in the Cabo Verde Is, the Canary Is and Madeira, in the Macaronesian region (Egea & Torrente 1994). The two latter species differ in having narrower asci (14-17 µm) and ascospores (3.5-5 µm), and by their saxicolous habitat. In addition, **L. subcaesoides** has more rounded and shorter ascomata (0.2-0.7 mm).

Lecanographa tehleri Egea, Sérusiaux, Torrente & Wessels sp. nov. (Fig. 2 E-G)

Thallus crustaceus, brunneus, ecorticatus. Ascomata lirellata (0.4-1 x 0.2-0.4 mm), subimmersa vel adnata. Discus pruinosus. Paraphysoides ramosae et anastomosantes, usque ad 2 µm crassae. Asci fissitunicati, 60-65 x 14-15 µm. Ascosporae fusiformes, 18-21 x 5-6 µm, (4-)5-septatae, halonatae, primum incoloratae, deinde brunneae. Pycnidia immersa. Conidia recta, 6-7 x 1 µm.

Typus: Namibia, Laguneberg Range (S part), N of Myl 72, basalt hill facing the sea, alt. c. 150 m, on small twigs of a shrub, 2. 1983, E. Sérusiaux 5199 & D. Wessels (LG-holotypus).
Other specimen examined: Road from Swakopmund to Hentiesbaai, 2 km S of Myl 14, coastal flats, marble outcrops, on twigs of a dead shrub, 2.1983, E. Sérusiaux 5057 & D. Wessels (LG).

Thallus crustose, brownish, cracked, with a granulose surface, without any distinct prothallus, very thin in section, ecorticate; medulla white with crystals of unknown nature (insoluble in K) incorporated between the hyphae. Photobiont: a species of Trentepohliaceae.
Ascomata lirelliform, 0.4-1 x 0.2-0.4 mm, simple, subimmersed to +/- adnate, scattered or rarely crowded, with a conspicuous margin, pruinose; disc plane, widened at maturity. Excipulum well developed, dark brown. Hymenium hyaline, 100-140 µm thick, I+ blue or reddish. Subhymenium brownish, 20-25 µm thick. Paraphysoids up to 2.5 µm wide, sparingly branched, slightly widened at the apices, and with slightly pigmented walls forming a greenish epithecium. Asci of the *Grumulosa*-type (Torrente & Egea 1989), 60-65 x 14-15 µm at maturity, with a distinct ring structure. Ascospores 18-21 x 5-6 µm, (4-)5-septate, fusiform, surrounded by a thick gelatinous sheath, hyaline but turning brown when old; cell walls thin and not or slightly widened at the level of the septa. Pycnidia immersed, secondarily multilocular. Conidia 6-7 x 0.8 µm straight.

Chemistry: Thallus K-, C-, P- ; no lichen substances detected by TLC.

Distribution and habitat: **Lecanographa tehleri** is known from two localities in the coastal areas of the Namib desert. It is an epiphytic species growing on twigs of shrubs. The lichen vegetation of the type locality is similar to that of the site where **L. longicarpa** grows (see above).

Notes: The size of the asci and the number of septa of the ascospores suggest some affinities with **Lecanographa lynceoides** (Müll. Arg.) Egea & Torrente (known from a single locality in coastal areas in Venezuela; Egea & Torrente 1994), which differs in having narrower (1.5-2 µm) and much branched paraphysoids, narrower (4-5 µm) and more or less constricted ascospores, and a dark brown epithecium. A further closely related taxon occurs in coastal areas of California and will be described in a forthcoming paper by two of us (J. M. E. & P. T.) as a subspecies of **L. tehleri**.

ACKNOWLEDGMENTS

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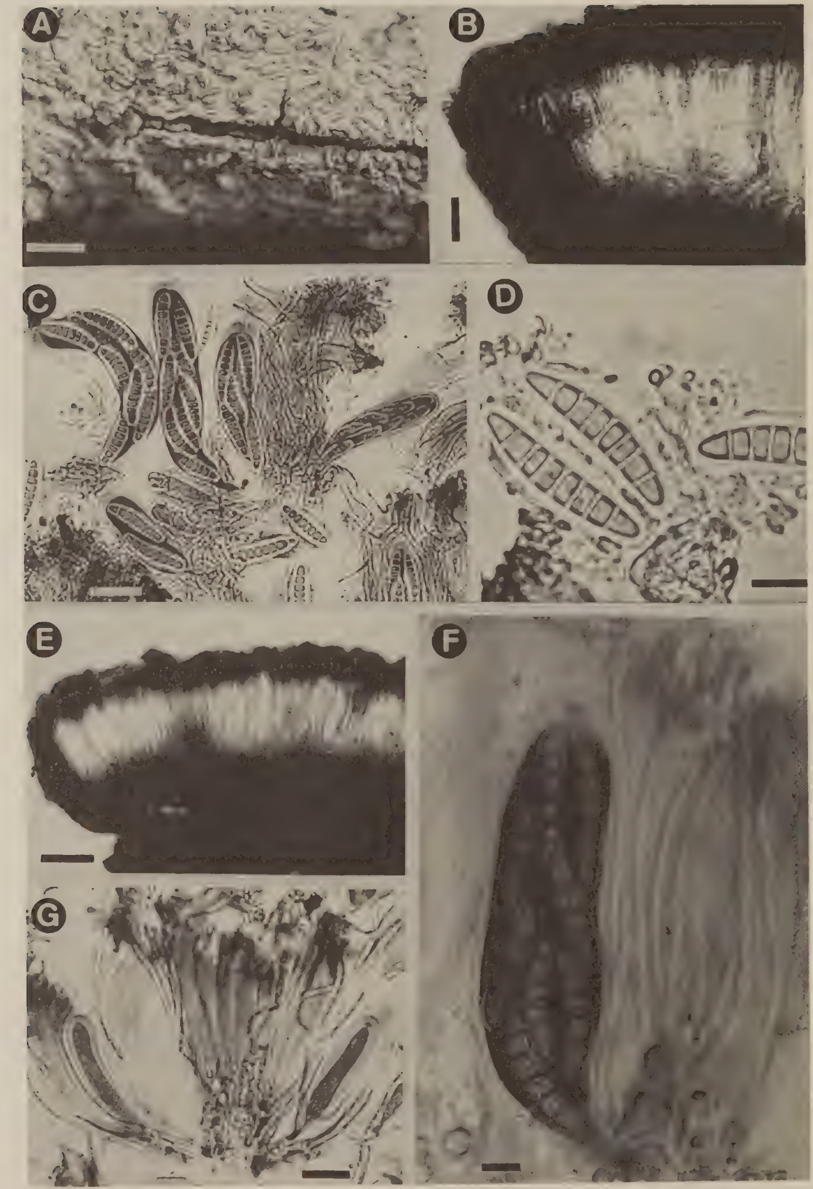
Figure 2. A-D, **Lecanographa longicarpa** (holotype). A, Habit. B, Vertical section of an ascoma. C, Hymenium after squash. D, Ascospores. E-G, **Lecanorapha tehleri** (holotype). E, Vertical section of an ascoma. F, Hymenium after squash. G, Asci. (C-D, F-G mounted in K/I). Scales: A = 3 mm; B = 25 μm; C, G = 20 μm; D, F = 10 μm; E = 50 μm.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CORTBASE - A NOMENCLATURAL TAXABASE OF CORTICIOID FUNGI (HYMENOMYCETES)

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Abstract

A nomenclatural database of corticioid fungi (Corticiaceae s.l. and related hymenomycetes) with basionyms, synonyms, taxonomically correct names, data on usage and evaluation of nomenclatural status has been compiled. The data retrieval program enables data to be viewed on screen, write to a text file or printer; it is available as freeware. The database includes 7333 fungal names; of 3912 basionyms, 1733 are legitimate names for accepted species, 1287 are facultative synonyms, and 884 are of uncertain application.

Key words: Corticiaceae, Hymenomycetes, Nomenclature, Databases.

Introduction

The corticioid fungi (Corticiaceae s.l.) are a group of hymenomycetes characterized by a usually resupinate basidiome and smooth, slightly colliculose, warted or folded hymenophore. In some genera or higher taxa there are also species with effused-reflexed or rarely pileate basidiomata, or with a hydnoid or poroid hymenophore. It is not a monophyletic taxon, but a *grade* or a group of related *life forms*.

There is no generally accepted classification of these fungi. Almost 150 new, usually small, genera have been published during the last forty years; most of the large genera are paraphyletic. More than 1280 species described since 1753 have been synonymized later, about 880 are of unknown identity. Many species have been combined under several genus names; in numerous cases, incorrect authors' names and erroneous citations have been used in later publications. For further taxonomic studies, and for correct naming, a nomenclatural database was compiled by the author. In most cases, original publications of taxa were checked. Authors' names are abbreviated using the Brummitt & Powell's handbook (1992), names of periodicals are mostly abbreviated according to the B-P-H directory (Bridson & Smith, 1991).

To make the database usable for taxonomists, a data retrieval (searching) program was written in *Clipper* language; this makes the database autonomous, i.e. no other program (dBASE, FoxBase, FoxPro, ACCESS or other) is needed for its use. Together with the index files, it is about 7 MB; it may be used on any IBM PC-compatible (DOS) personal computer which has 512 KB or more of free RAM and DOS 3.3 or higher system. In other words, it is usable even on an old XT computer.

This is the first version of the database; there are several species not yet included due to unavailability of some old literature, and surely several mistakes. In many species, the type and the herbarium where it is kept is not yet indicated. The compiler hopes to continue his efforts and release a new version once a year. All corrections and any criticism will be appreciated.

Coverage

The limits of the group *corticioid fungi* are arbitrary. In addition to the genera and species traditionally included to the (artificial) family Corticiaceae s.l., some related but usually clearly distinguishable groups (Coniophoraceae, Dichostereaceae, Steccherinaceae, Stereaceae, stipitate stereoid fungi, Thelephoraceae s.str., Tulasnellales, some groups of polyporoid fungi) are included by some mycologists and excluded by others. In this database, the species of these groups are mainly included when they have obligate or faculative synonyms under the genus names of the 'true' corticioid fungi.

What are *names in current use*?

To avoid inadvisable name changes, and to help biologists inexperienced in taxonomy to use correct names, an international project *Names in Current Use* (NCU) has been initiated and widely supported (cf. Hawksworth, 1991). As one of the main results, a list of generic names in current use of plants and fungi was published a few years ago (Greuter et al., 1993). One of the questions to be solved before compiling a NCU list of species names is to define the time limits of the term *current*. The Special Committee on NCU defined the names as 'legitimate names adopted in the most recent revision (if any) of the corresponding group, or in a recent flora within whose limits a given taxon occurs...' (Greuter, 1993: xvii).

In some groups of fungi, 'most recent revisions' are lacking. There are several 'good' species described in the beginning of this century in tropical or other regions not visited by collectors afterwards, and not mentioned for decades. There are groups for which no taxonomist is currently actively working. Obviously, for any large group of organisms, the time line for NCU must be different. In the *CORTBASE*, four periods of use of a name have been indicated: 1890-1924; 1925-1954; 1955-1969; 1970 and later. The names used after 1954 are said to be the names in current use in this database. Nevertheless, several names not used after this date may be for 'good' species but have not been included in recent monographs and key works.

Taxonomically correct names

The *CORTBASE* is a nomenclatural, not a taxonomic database. Nevertheless, it was unavoidable for the compiler not to give for every species one *taxonomically correct name* when possible, otherwise the database would be of little use for many mycologists. In most cases, the 'correct name' is a name used in the newest surveys of corticioid fungi by Hjortstam (1987), Ginns & Lefebvre (1993) and Hjortstam & Larsson (1995). The classification used by them is characterized by extreme splitting of genera; however, there is a slight tendency to put together some genera again.

The compiler of *CORTBASE* has different opinion in several areas on the classification of corticioid fungi but it would be inappropriate to make any taxonomic rearrangements in this database. For a taxonomist who does not agree with the arrangement used by the corticiologists indicated above, the option *data on a species* of the data retrieval program presents all available names for selection according to anybody's taste.

In following Ginns, Hjortstam, Larsson and Lefebvre, some few cases where nomenclaturally unacceptable names have been indicated as correct ones have been revealed including the species of the genus *Phlebiella* P. Karst. According to the Art. 42.1 of the International Code of Botanical Nomenclature (Greuter & al., 1994), this genus is not validly published (Donk, 1963: 163). It has not been described in Latin after 1934, or in any other language before this date. Nevertheless, the compiler of the database retained this taxonomically 'good' but invalid genus to have its species retrievable. There are also some other species names in current use in spite of their nomenclatural invalidity, and some names published *ad int.* have been used due to the unavailability of a valid name.

There are hundreds of species described in or named under the 'corticioid' genus names *Merulius* Boehm. non Fr.: Fr., *Irpex* Fr.: Fr. and *Hypochnus* Fr. which really belong to the unrelated groups Agaricales, Cantharellales, polypores, pyrenomycetes, etc. The compiler has not yet been able to find nomenclaturally correct names for all these species, and possibly there are several mistakes. It will take several years before in a future version of the database these most enigmatic names will be deciphered - if they ever will be.

Data on species (validation, sanctioning, periods of use)

When compiling the database the question of valid publication of names had, in many cases, to be solved arbitrarily. According to the Article 32.4 of the International Code of Botanical Nomenclature (Greuter et al., 1994), when coining a new combination, a direct or (before 1953) indirect reference to its basionym must be given. It may be simply its author's name (Art. 32.5); however, in the Examples 5-8 at this Article, more information than only name has been indicated. When Kuntze combined more than 300 species of corticioid fungi in the genus *Terana* Adans. in 1892, the only 'indirect reference' was the basionym's author's name abbreviation, sometimes misprinted. If similarly proposed new combinations are to be considered invalid, many names in current use must be replaced by new ones, including the names combined by Patouillard, Bondartsev & Singer and others. To avoid these name changes, we have to be extremely tolerant towards new combinations based on indirect references in the older literature.

Many basionymic names of corticioid fungi have been sanctioned by Fries. In such cases, a reference to their author and place of valid publication has been given in two different ways. Most authors have indicated the citation published in one of the Fries' validating books (e.g., *Merulius tremellosus* Schrad. : Fr., Syst. mycol. 1: 327, 1821.) For the compiler of this database, when a name of a species described earlier was sanctioned, a special status to an already existing name has been assigned by Fries. Accordingly, not the place of sanctioning but the place of valid description of a species is the most important information to be given in a citation. In the database, this is given [e.g.: *Merulius tremellosus* Schrad. : Fr. (1794) in Spic. fl. Germ. 139. - Sanctioned by Fries in Syst. mycol. 1, 1821.] In this, I have followed the suggestions given by Gams & Kuyper (1995: 28-29).

In the database, the period of use of a name is indicated independently of its taxonomic status; it is not an evaluation of the nomenclatural status but an item of information to be used with some caution. The nomeclatural status is indicated using the words *legitimate, validly published but illegitimate, not validly published*, and *rejected in this genus*. When a species was published under a misapplied generic name, its status is only mentioned when not validly published.

Use of the program

After copying the files into a new (sub)directory, the command *INSTALL* unzips and installs the database. To use the program, type *CORT* . In the popup menu, there are four options.

1. *Check a name.* Data on species name (incl. author and citation), its basionym and taxonomically correct name will be given.

2. *Data on a species.* Full data on a species, its basionym and correct name, but also on all obligate and facultative synonyms, including data on type, sanctioning, time periods when a name was used, its nomenclatural status (validly published or not, legitimate or not) are given. When a species was synonymized with another, the mycologist proposing this is mentioned after the word *sec.*

When inputting a species name in using the first and second options, incorrect termination of the species epithet is admittable (e.g., *aurea* instead of *aureus*).

3. *List of all species of a genus* includes correct as well as all incorrect, illegitimate and not validly published names of species used under this genus name. Data on the species name as well as on its basionym and correct name are given.

4. A list of *accepted taxonomically correct names* of a genus includes data on the name and its basionym.

When using options 2-4, the data may also be written into a text file and/or printed.

Availability of the taxabase and searching program

The database and program are released on a 3.5" or 5.25" floppy disk as freeware, i.e. for handling and mailing cost only, and may be freely copied. When it is used for preparing a publication, please cite it in the list of literature by refferring to this article published in "Mycotaxon".

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NEW REPORTS OF THE GENUS *Pluteus* (AGARICALES) FROM MEXICO

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ABSTRACT

Three species of *Pluteus* from the state of Jalisco are reported for the first time from Mexico. *Pluteus exilis* Singer and *P. sanctixaverii* Singer were found in tropical or subtropical areas, while *P. globiger* Singer & Digilio was collected in a pine forest.

INTRODUCTION

Pluteus is one of the agaric genera that has not been studied well in Mexico. Only 19 species of the 150 species recognized by Singer (1986) have been reported from the country (Murrill, 1911, 1917; Singer, 1956, 1973; Cifuentes & Guzmán, 1981; Guzmán, 1983; Mora & Guzmán, 1983; Pérez-Silva & Aguirre-Acosta, 1986; Cifuentes *et al.*, 1989; Candusso *et al.*, 1994 and Esqueda-Valle *et al.*, 1995), and three of these were recorded from the state of Jalisco: *P. aurantiorugosus* (Trog)Sacc., *P. chrysophlebius* (Berk. & Rav.)Sacc. and *P. harrisii* Murrill (Vargas *et al.*, 1992, 1993).

In this paper another three species are reported from Jalisco, and for the first time from Mexico: *P. exilis* Singer of the Section **Pluteus** Fr., and *P. globiger* Singer & Digilio and *P. sanctixaverii* Singer of the Section **Celluloderma** Fayod. The Section **Pluteus** is characterized by the presence of metuloid pleurocystidia, usually with apical horns (*cervinus*-type) or sometimes without apical ornamentation (*magnus*-type), as well as a filamentous pileipellis with cylindric or cylindric-fusoid end cells. On the other hand, the Section **Celluloderm** exhibits thin-walled pleurocystidia and a palisadoderm of sphaeropedunculate cells in the pileipellis (Homola, 1972).

DESCRIPTION OF THE SPECIES

Pluteus exilis Singer, **Fieldiana, Bot. 21**: 94, 1989. Figs. 1-4

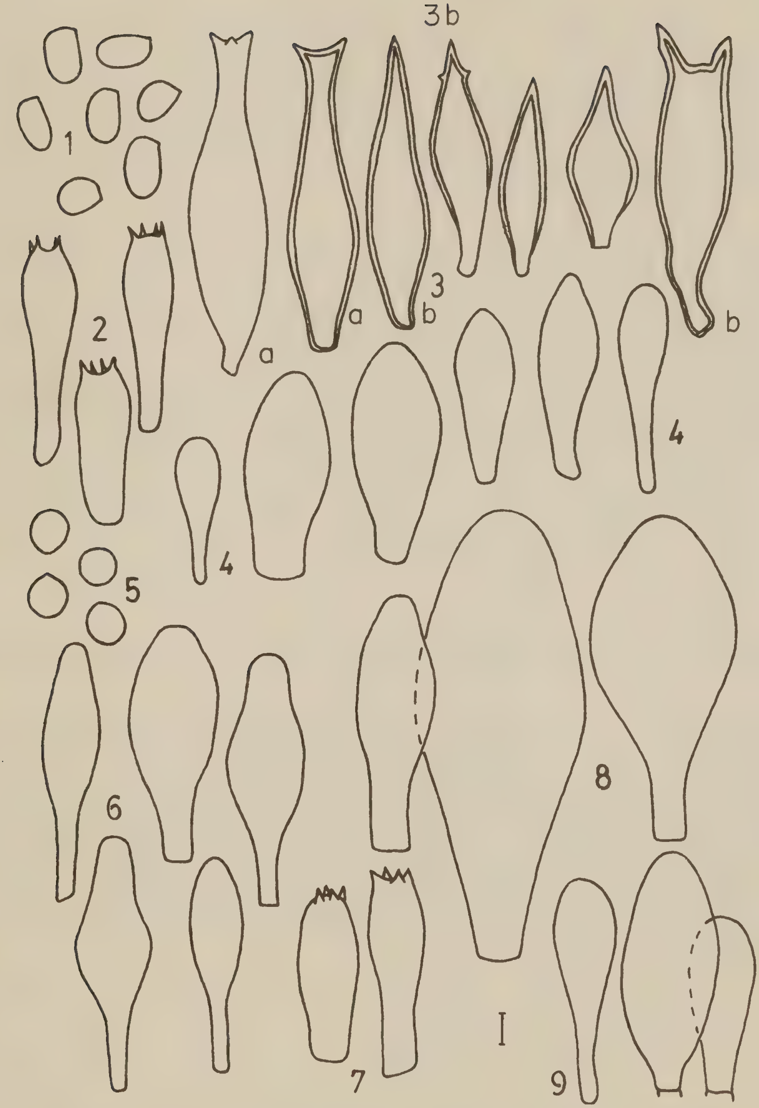
Pileus 6.5-8 cm broad, campanulate to plane-campanulate, viscid to lubricous, glabrous to finely velvety-tomentose in the disc, margin even, surface light brown, disc dark brown, and edge cream. **Lamellae** free, close, very broad, whitish to pink, edge concolour to slightly paler, flocculose. **Stipe** 5 x 0.8 cm, equal to gradually enlarged below, silky, finely striate-rugose, white with the base grayish-brown. **Context** white, smell and taste fungoid.

Basidiospores 5.2-7.2(-8) x (3.2-)4-5.2 μm, subglobose to broadly ellipsoid, few oblong, smooth, with thin wall, hyaline. **Basidia** 21.6-32 x 6.4-8.8 μm, tetraspored, claviform, with refringent content, hyaline. **Pleurocystidia** dimorphic: 1) (47.2-)50.4-93.6 x (11.6-)14.4-20 μm, abundant, *magnus* type, fusoid-ventricose, some with lateral short acute projections toward the apex, present on lamellae face and edge, and 2) (52-)65.2-102.4 x 14.8-22 μm, scarce, *cervinus* type, fusiform, apex with 2-3 horns, acute to slightly obtuse, some branched; both types intermixed, with walls uniformly thick, 1.2-2 μm, hyaline. **Cheilocystidia** (18.4-)25.6-51.6(-68) x (3.6-)7.6-15.2(-21.6) μm, also dimorphic: 1) subfusoid to subfusoid-ventricose, apex rounded to subrostrate, and 2) spathulate to claviform-subvesiculose; with thin wall, hyaline. **Hymenophoral trama** inverse. **Pileipellis** a trichoderm, with hyphae 29.1-93.6 x 3.6-5.6 μm, apex rounded, suberect to erect, with thin to subthick wall, hyaline or light yellowish-brown. **Clamp connections** absent.

Habit and habitat. Gregarious, on a stump in a garden, in a subtropical zone with some introduced trees such as *Pinus*.

Specimens examined. JALISCO, Guadalajara County, City of Guadalajara, altitude 1600 m, September 19, 1990, *Guzmán-Dávalos 5228* **(IBUG)**.

Observations. The studied Mexican material agrees with Singer (1989) and Banerjee & Sundberg (1995), who reported the species from U.S.A. This fungus is related to *P. major* Singer, because of the dimorphism in pleurocystidia and occasionally in the cheilocystidia. However, *P. major* has a thinner pleurocystidia wall, and the pileipellis is of ixotrichoderm type (Banerjee & Sundberg, *op. cit.)*.



Figs. 1-9. 1-4: *Pluteus exilis*, 1: spores, 2: basidia, 3: pleurocystidia, a) *cervinus*-type, b) *magnus*-type, 4: cheilocystidia. 5-9: *P. globiger*, 5: spores, 6: pleurocystidia, 7: basidia, 8: cheilocystidia, 9: elements of pileipellis (Scale bar = 4 μm, except 3, 4, 6 & 9 = 8 μm).

Pluteus globiger Singer & Digilio, **Lilloa 25:** 266-268, 1951. Figs. 5-10

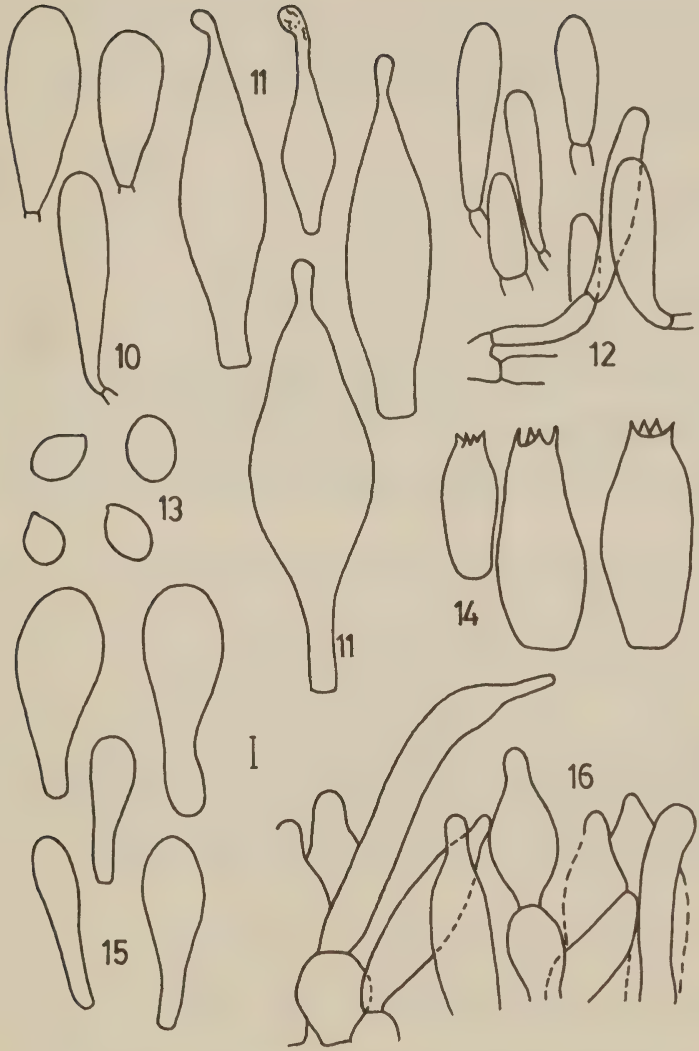
Pileus 1.6-3.1 cm broad, convex-campanulate, not umbonate to subumbonate, smooth to venose-striate toward the centre in dried specimens, margin striate, surface grayish-yellow to yellowish-brown, hygrophanous, sublubricous. **Lamellae** free, close, broad, yellowish to grayish-white, edge slightly lighter. **Stipe** 2.5-4 x 0.1 cm, subbulbous, fibrillose, silky, slightly floccose overall, compact to hollow, yellowish-white with a reddish-brown tint, base velvety, whitish-yellow. **Context** thin, grayish-yellow.

Basidiospores 4.8-6.4 μm, globose, smooth, with subthick wall (0.8 μm), with refringent content, hyaline. **Basidia** (19.2-)20.8-26.4 x 6.4-8 μm, tetraspored, claviform, with refringent content, hyaline. **Pleurocystidia** (45.6-)52-64(-76) x 11.2-20(-24) μm, inflated-clavate to ventricose-rostrate, with rounded apex to slightly obtuse, long pedicellate, with subthick wall (0.8 μm), and refringent content, hyaline. **Cheilocystidia** 32-64 x 8.8-25.6 μm, similar in size and form to pleurocystidia, also with a subthick wall (0.8 μm), and refringent content, hyaline. **Hymenophoral trama** inverse. **Pileipellis** hymeniforme, cells (32.8-)40-76(-94.4) x (10.4-)12.8-23.2 μm, clavate to inflated-clavate, with rounded apex, with subthick wall (0.8-1.2 μm), hyaline or some pigmented yellowish-brown. **Stipitipellis** with elements 38.4-59.5 x 12-18.8 μm, clavate to subcylindric-clavate, mostly toward the base, hyaline. **Clamp connections** absent.

Habit and habitat. Gregarious, lignicolous on rotten wood, in a *Pinus* forest.

Specimens examined. JALISCO, Mazamitla County, near Mazamitla, altitude 2160 m, June 21, 1987, *Guzmán-Dávalos 3751* **(IBUG).**

Observations. This species was only known from South America (Argentina, Bolivia and Chile), and it is distinguished by the yellowish pileus, context, lamellae and stipe, and for its globose basidiospores. The revised material agrees with Singer & Digilio (1951), Singer (1958) and Horak (1964). However, the elements of the pileipellis according to Singer (*op. cit.*), are sphaerocysts globose or subglobose pedicellate, 28-58 x 20-37 μm and according to Horak (*op. cit.*) are globose or vesiculose elements, (20-)30-46 x (14-)28-36 μm. Probably the Mexican material is a new species, but we need to study more material and the type of *P. globiger*.



Figs. 10-16. 10: *Pluteus globiger*, elements of stipitipellis. 11-16: *P. sanctixaverii,* 11: pleurocystidia, 12: elements of stipitipellis, 13: spores, 14: basidia, 15: cheilocystidia, 16: elements of pileipellis (Scale bar = 4 μm, except 10 & 12 = 8 μm).

Pluteus sanctixaverii Singer, **Lloydia 21:** 264, 1958. Figs. 11-16

Pileus 0.6-2 cm broad, convex, subumbonate, disc rugous to slightly fibrillose toward the margin, edge striate-sulcate, surface grayish-yellowish-brown to grayish-brown, disc dark grayish-brown. **Lamellae** free, subclose, broad, pink, edge concolorous and flocculose. **Stipe** 1.5-2.5 x 0.2-0.3 cm, equal, smooth to flocculose mostly toward the base, whitish, yellowish-brown when dry. **Context** very thin, whitish.

Basidiospores (6.8-)7.2-8.4(-9.6) x 5.6-7.2 μm, subglobose to broadly ellipsoid, smooth, with subthick wall (0.8 μm), and refringent content, hyaline. **Basidia** 24-32 x 8.8-12 μm, tetraspored, claviform to claviform-inflated, with refringent content, hyaline. **Pleurocystidia** 32-54.4 x 9.6-16 μm, scarce, easily collapsed, ventricose-fusoid, rostrate, apex subcapitate, with thin wall, and refringent content, hyaline. **Cheilocystidia** 16-39(-46) x 7.2-19.2 μm, claviform-inflated to spathulate, with thin wall, and refringent content, hyaline. **Hymenophoral trama** inverse. **Pileipellis** heterogeneous, formed by sphaerocysts or subisodiametric elements, with or without pedicel, 24-28(-60) x (14-)16.8-28.8 μm, with thin to thick wall up to 1.6 μm, or spathulate, claviform or ventricose-rostrate to submucronate elements, (28.8-)44-68 x 12-22.4 μm, with thin to thick wall; both with refringent content, hyaline. **Stipitipellis** with elements of 25.6-64 x 5.6-13.2 μm, claviform to cylindrical, with thin wall, hyaline. **Clamp connections** absent.

Habit and habitat. Gregarious, lignicolous on branch debris in a tropical deciduous forest.

Specimens examined. JALISCO, Guadalajara County, Barranca de Huentitán, altitude 1250-1500 m, March 29, 1989, *Vázquez 890* **(IBUG)**.

Observations. The studied material agrees with Singer (1958), except in the cheilocystidia, "vesiculose frequently with apex acute". The type of *P. sanctixaverii* (Singer T-2878, LIL) was studied, but the pleurocystidia and cheilocystidia were not observed due to the poor condition of the material; the basidiospores are 6.8-8 x 5.6-6.8 μm, the basidia 26-30.4 x 11.2-12 μm and the pileipellis elements 16.8-40 x 9.6-16.4 μm. This species had only been reported from Argentina.

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A NEW SPECIES OF SERENOMYCES FROM DATE PALM IN CALIFORNIA

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SUMMARY

The new species *Serenomyces virginiae* is described from date palm in California.

A collection on rachides of date palm, *Phoenix dactylifera* L., revealed an interesting species of *Serenomyces*. This taxon forms elongate stromata up to 35 mm long on dead rachides (Plate 1, A-C), but produces only small chlorotic spots on living material. As in other species of *Serenomyces* (Barr et al. 1989), the apices of ascomata are marked by short papillae and the ovoid asci are deliquescent (Plate 1, F). The broadly ellipsoid, obtusely ended ascospores in the new taxon are conspicuously longitudinally ridged (Plate 1, G,I) as they are in the apiculately ended ascospores of *S. californicus* (Plate 1, H,J). The new taxon differs from the other known species of *Serenomyces* by configuration of the pseudostroma and wider, more conspicuously ornamented ascospores. *Serenomyces phoenicis* (Rolland) E. Müll. & S.Ahmad (1962), on date palms in the Mediterranean region eastward to Pakistan, has smaller pseudostromata and smaller, narrower ascospores. The ascospores of *S. palmae* E. Müll. (Müller and Dennis 1965) are quite similar in sizes and obtuse ends to those of the new taxon, but they tend to be inequilateral and the pseudostromata are smaller.

Serenomyces virginiae M.E. Barr, Ohr, Ferrin, & Mundo-Ocampo, sp. nov.

Pseudostroma immersa subepidermalia 25-35 mm longa composita cellulae nigrae et cellulae hospitis. Ascomata 300-900 µm lata 200-300 µm alta papillata. Asci unitunicati ovoidei deliquescentis circa 45-50 x 20-22 µm paraphysati. Ascosporae 14-18(-21) x 9-10 µm spadiceae unicellularis ellipsoideae, parietes longistrorsum costati. Holotypus in rhachidibus mortuis *Phoenicis dactyliferae* L. "USA: California, Riverside Campus University of California, 13 Feb 1995," a H.D. Ohr lecto in BPI depositus, isotypus in NY depositus.

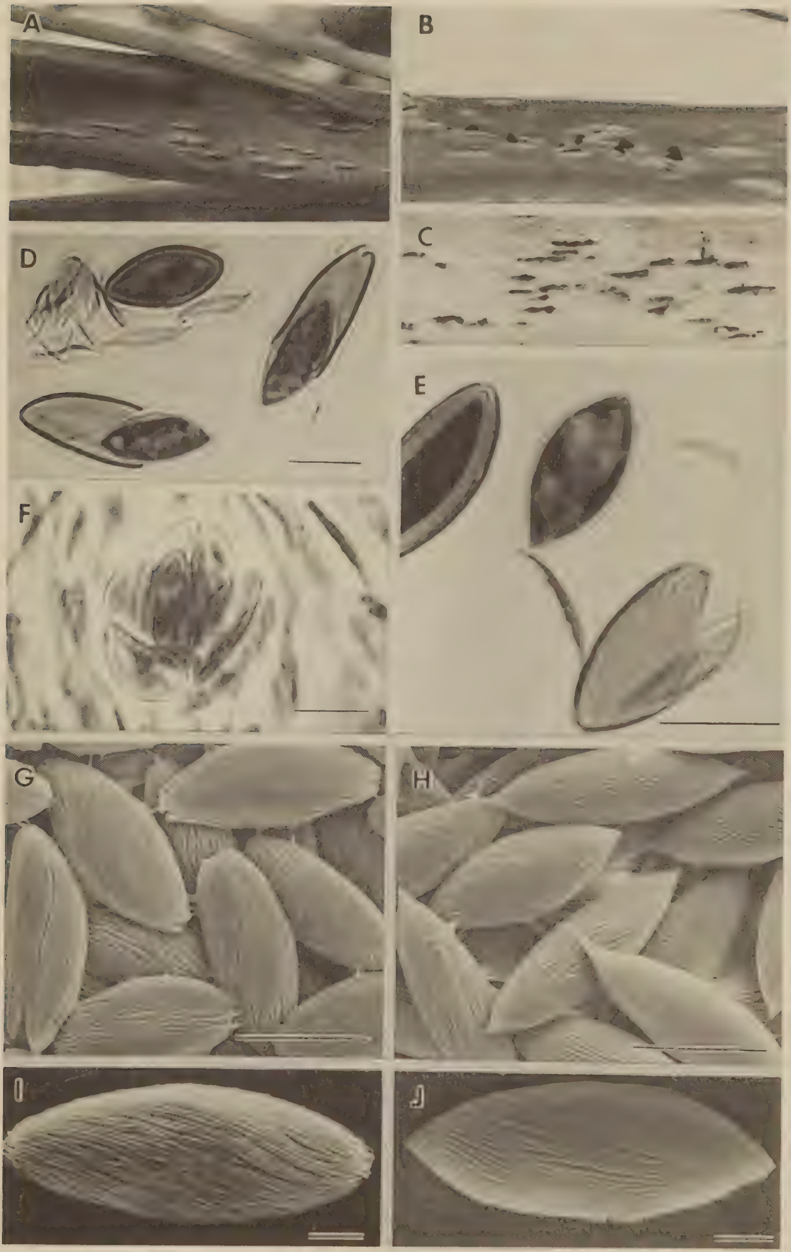
Pseudostromata immersed in and beneath epidermis, raising and splitting epidermis in long ridges 25-35 mm long, 1.5-2.5 mm wide, 550-600 µm high, blackened above and at base over and between sclerenchyma bundles, heavily melanized, internally grayish around ascomata, of interwoven hyphae. Ascomata numerous, depressed, ca. 300-900 µm wide, 200-300 µm high, opening by low rounded papillae; peridium narrow, brown. Asci basal, ca. 45-50 x 20-22 µm, thin walled, deliquescent. Paraphyses as compressed strips, deliquescent. Ascospores 14-18(-21) x 9-10 µm, bright brown, ellipsoid, ends obtuse, unicellular; wall thick, dark brown, up to 1 µm, surface longitudinally ridged; containing one globule and granules; crowded in the ascus.

On dead rachides of *Phoenix dactylifera*, California.

The specific epithet is chosen to honor the wife of the second author.

The dark brown ascospores are interesting for the exosporial layer can be removed to free the hyaline ascospores (Plate 1, D,E). This is readily demonstrated by applying pressure to a coverslip over an aqueous suspension of the ascospores on a glass slide. Extruded ascospore masses over the stromata may be invested by hyphae, conidiophores and conidia of a species of *Cladosporium*, evidently *C. cladosporioides* (Fresen.) G.A. de Vries.

Plate 1, A-G, I. *Serenomyces virginiae*. A-C. Stromata and masses of ascospores on rachides of *Phoenix dactylifera*. D, E. Ascospores within or freed from their exosporial layer (stained with lactophenol-cotton blue.) (Scale bar = 12.5 and 10 µm for D and E, respectively.) F. Immature ascospores within an ascus surrounded by paraphyses (stained with lactophenol-cotton blue.) (Scale bar = 10 µm.) G, I. Scanning electron micrographs of ascospores. (Scale bar = 10 and 2 µm for G and I, respectively.) H, J. *Serenomyces californicus*. Scanning electron micrographs of ascospores. (Scale bar = 10 and 2 µm for H and J, respectively.)


A
B
C
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Ascospores from fresh plant material germinated and grew well on media such as V-8 juice agar. The hyphae of both single-ascospore isolates and those obtained from infected rachises were heavily melanized, the degree of melanin production varying with the composition of the medium and the temperature at which the cultures were grown. A graph of the growth responses of *S. virginiae* over a range of temperatures (Fig. 1) indicates that the optimal temperature is 30-33 C, similar to that previously reported for *S. californicus* (Barr et al. 1989). The isolates are not particularly stable in culture and readily lose their ability to produce melanin. Neither conidiomata nor ascomata were formed in culture.

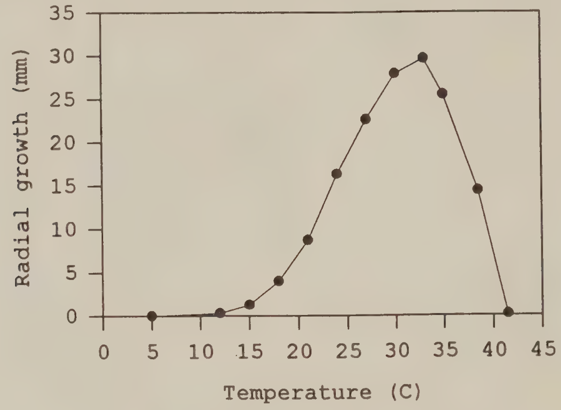

Figure 1. Radial growth of monoascosporic isolates of *Serenomyces virginiae* on V-8 juice agar grown at various temperatures for 7 days.

ACKNOWLEDGMENTS

We thank Dr. Kevin D. Hyde for reviewing the manuscript.

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MYCOTAXON

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PERTUSARIA SPILOTA, A NEW LICHEN SPECIES (LICHENISED ASCOMYCOTINA) FROM NEW ZEALAND

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ABSTRACT: *Pertusaria spilota* A.W. Archer & Malcolm is reported as a new corticolous species from New Zealand.

INTRODUCTION: The lichen genus *Pertusaria* in New Zealand was reviewed by Galloway (Galloway 1985) and additional taxa have since been described (Archer & Elix 1994; Elix, et al.1995). Further collecting in the north of the South Island of New Zealand has led to the discovery of an additional inconspicuous, corticolous species which is described here.

Pertusaria spilota A.W. Archer & Malcolm, sp. nov. Fig. 1

Thallus albidus vel grieo-albidus, tenuis, rimosus vel diffusus, superficies laevis et hebetata, isidiis et sorediis destitutus; corticola; apothecia veruciformia, perplano-hemisphaerica, percomplanata,, conspicua, dispersa,nigro-cineracea vel virella, 1-2 mm diam.; ostiola inconspicua, nigra, in verrucis 1-2na, 0.05-0.1 mm diam.; sporae 8nae, uniseriatae, ellipsodeae, laeves, (50-)60-65(-75) μm longae, 25-30 μm latae.
Materia chemica in thallo non detecta.

Type: NEW ZEALAND, South Island, Nelson, Mt. Arthur, track to hut, 41°12'S, 172°44'E, alt. 1080 m, on bark of fallen *Nothofagus menziesii*, *W.M. Malcolm 2562*, 14.xi.1995; CHR 507218-holotype; CANB, NSW-isotypes.

Thallus off-white to pale grey, thin cracked or diffuse, surface smooth and dull, lacking isidia and soredia, corticolous; apothecia verruciform, markedly flattened hemispherical, scarcely rising above the thallus surface, scattered, conspicuous, greyish black to greenish, 1-2 mm diam.; ostioles inconspicuous black, 0.05-0.1 mm diam., 1 or 2 per verruca; spores 8 per ascus, ellipsoid, smooth, 1-seriate, (50-)60-65(-75) μm long, 25-30 μm wide.

Chemistry: K-, KC-, C-, Pd-; no lichen compounds detected by thin-layer chromatography.

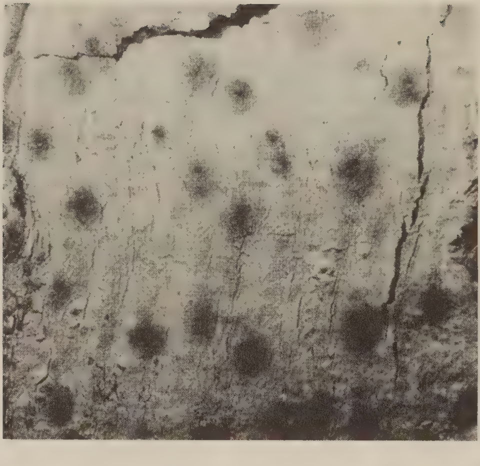

Fig. 1 *Pertusaria spilota* A.W. Archer & Malcolm, holotype, x 4

Specimens examined:
NEW ZEALAND, South Island, Arthurs Pass National Park, 6.5 km N of Cass, 42°49'S, 171°45'E, alt. 685 m, on trunk of fallen *Nothofagus solandri*, *Leif Tibell 9537*, 12.xi.1980 (UPS); Murchison, Matakitaki West Bank Road, on bark of fallen *Nothofagus menziesii*, 250 m, *W.M. Malcolm 2371*, 25.viii.1995 (NSW p.p.)

Pertusaria spilota is characterised by the scattered, inconspicuous, markedly flattened verrucae, the 8-spored asci and the absence of lichen compounds. The new species resembles *Pertusaria albissima* Müll.Arg., described from New Zealand (Müller 1884) which also has 8-spored asci and lacks lichen compounds, but has numerous, conspicuous verrucae (Archer & Elix 1994) in contrast to *Pertusaria spilota*. The species was first collected by Dr. Leif Tibell in 1980 and is, so far, known only from the South Island of New Zealand. The epithet "spilota", from the Greek "spilos", a spot, refers to the spotted appearance of the thallus.

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The authors are grateful to Mr. D. Verdon for checking the Latin descriptions and to Professor J.A. Elix for helpful discussion; one of us (AWA) is grateful to the National Herbarium of New South Wales (NSW) for arranging the loan of specimens and for permission to use the facilities of the Herbarium.

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MYCOTAXON

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BOOK REVIEWS

D. S. Hibbett, Book Review Editor

Guía Ilustrada de los Hongos del Jardín Botánico Franscisco Javier Clavijero de Xalapa, Veracruz y Areas Circunvecinas, by Santiago Chacón, Gastón Guzmán, Leticia Montoya y Victor M. Bandala. 230 x 167 mm, 142 pp, 23 colored plates, 17 black and white plates, 1995. Intituto de Ecología, A.C. Xalapa, Veracruz, México. Apartado Postal 63, Km. 2.5 Antigua Carretera a Coatepec, Xalapa 91000, Veracruz, México. ISBN 968-7213-75-2 M.N.$ 120.00 ; US $20.00

The tropics and subtropics are rich in fungi. This book is a fine introduction to the great diversity of fungi present in Mexico. The study area treated in this guide is a protected region of subtropical vegetation that is supported by the Instituto Nacional de Ecología A.C. This book will be useful to both amateurs and professionals who are interested in knowing more about the diverse fungi of this region.

There are few concise guides to the fungi of Mexico, which makes this new text all the more valuable. The contents have been divided into nine parts: introduction; a short description of the "Francisco Javier Clavijero" Botanical Garden and neighboring areas, biology of fungi and methods for studying fungi; fungi considered in this guide; fungi on soil and leaf litter; wood decay fungi; dung fungi; parasitic fungi; and finally, observations on ecology, distribution, and economic importance of selected species. The guide shows, in a practical and simple form, aspects of fungus structure, with an emphasis on fructifications.

There are 153 fungus species considered in this work, including 125 Basidiomycetes, 15 Ascomycetes, 6 Deuteromycetes, 4 Myxomycetes, and 2 lichens. The classification employed and a list of synonyms is shown in one of the appendices. In addition to the systematic arrangement, taxa are grouped according to habitat, which will make this guide easy to use for individuals working in a particular habitat type. Each taxon is described in terms of macromorphology and developmental characters, microscopic characters, and other notable features, such as taste and smell. Information about toxicity is also reported. Species are illustrated with photographs or drawings. Unfortunately, the photographs do not always capture all of the important characters of the fungi. Nevertheless, the efforts made by the authors to illustrate all the species should be recognized.

This guide includes numerous ecological observations with many interesting details about the importance of these fungi for the ecosystem and their interactions with other organisms. The useful glossary has brief definitions of technical terms, often with reference to illustrations. Common names are also presented in an appendix. Thus, this guide is a valuable contribution to the ethnomycology of this region. The inclusion of common names will also facilitate identifications. Finally, the bibliography presented will allow access to specialized mycological publications.

The information in this work is basic and general. It is an important contribution to the knowledge of the fungi of the "Francisco Javier Clavijero" Botanical Garden and neighboring areas of Xalapa, and can also be used with certain limitations in similar ecosystems elsewhere in the Mexican Republic. *Joaquin Cifuentes and Margarita Villegas, Herbario de la Facultad de Ciencias UNAM. A.P. 70-399 Méxcio.*

DNA Fingerprinting in Plants and Fungi, by Kurt Weising, Hilde Nybom, Kirsten Wolff, and Weiland Meyer. 233 x 154 mm, 322 pp, 1995. CPC Press, Boca Raton, FL 33431. ISBN 0-8493-8920-8. US$ 64.95 Softcover.

I can enthusiastically recommend this book to any systematist with an interest in the use of molecular markers as organismal characters. It will be of greatest value to those seeking an introduction to the subject, largely because it aims to be a true, thorough introduction. For the more experienced worker, it also provides an excellent review of history, theory, methods, and applied literature (particularly studies of plant and fungal groups) as well as a handy and comprehensive reference. This is an eminently usable book.

What else would you expect from a work that on page two outlines a three-step plan for obtaining a grant and launching a career ("3. ...the new fingerprinter obtains a grant..."). From there the authors follow a straightforward path while imparting practical information clearly and directly. A contemporary undergraduate education in the biological sciences will be sufficient to understand the presentation.

At this point I should make clear that the focus of this work is actually upon one category of DNA markers: those which are repeated from several to many times in the genome. As Chapter 2, a review of molecular markers, explains, the multilocus markers used in DNA fingerprinting include mini-, micro-, and midisatellites composed of tandem repeats. This is the only area of molecular systematics in which the book attempts a comprehensive treatment. However, other approaches are not omitted, while many techniques used in fingerprinting are also applicable to single locus markers. For that reason I believe that this book provides a reasonable introduction to the larger subject of molecular markers.

Chapter 3 provides a thoughtful shopping list, well organized and prioritized, for the molecular lab. The real heart of the text is in Chapter 4: 110 pages of detailed methods for a wide variety of multilocus characterization techniques. The directions include recipes for reagents and step by step protocols, tips, cautions, and discussions of frequently encountered problems. Although collections of methods are available elsewhere, this is a good single source for a broad range of protocols. The final 18 pages of this chapter form a section on "Evaluation of fragment patterns" and cover both fragment sizing and matching and statistical procedures including genetic similarity and genetic distance computations, several population genetic analyses, and phenetic and phylogenetic analyses (the distinction is explained) that include ordination and clustering methods. This summary of analyses is concise but wide ranging, clear, and well referenced.

Chapter 5, on applications, is also long. If you have wanted to do a particular molecular project, something like it is probably described here. If you don't know what to do, here is a rich source of ideas. A large number of studies are summarized and referenced here. There is even a paragraph on the sexual problems of *Agaricus bisporus* (molecular help is on the horizon).

The two short closing chapters provide comparisons of alternative methodologies, including costs (in dollars) and benefits, and flag new techniques which may hold promise for future work. These are followed by more than 850 references (into 1993), four appendices referencing studies, organized by organism and technique, a list of suppliers of reagents, equipment, and software, and an index.

It is clear that the authors strive to help the reader become a successful DNA fingerprinter of plants or fungi. The book itself succeeds admirably. If you have any interest at all in this subject, you will likely be pleased to own this book. *Richard W. Kerrigan, Research Department, Sylvan, Inc., West Hills Industrial Park, Kittanning, PA 16201 U.S.A.*

Patterns in Fungal Development, edited by Siu-Wai Chiu and David Moore. 235 x 160 mm, 226 pp, 1996. Cambridge University Press, 110 Midland Ave., Port Chester, NY 10573-4930 U.S.A. Fax: 914-937-4712. ISBN 0521560470. US$ 54.95.

Systematic mycologists have long used developmental characters to group fungal taxa. More recently, some mycologists and developmental biologists have begun to explore the mechanisms of morphogenesis in a few fungal model systems. The integration of comparative and mechanistic approaches to fungal development has the potential to provide insight into phylogenetic relationships and the precise mechanisms of ontogeny and morphological evolution in fungi. **Patterns in Fungal Development** deals primarily with mechanistic studies, but the editors seem to appreciate the significance of their subject for evolutionary biology. The book is intended for both developmental biologists and mycologists. It is no easy task to bridge these disciplines, but this is necessary for progress in understanding fungal development and the editors are to be commended for their efforts in this direction. This review is written from the perspective of a fungal systematist.

Patterns in Fungal Development is a collection of eight papers that were presented at the Fifth International Mycological Congress in Vancouver, British Columbia, in August 1994. The first seven chapters are principally concerned with mechanistic studies (the editors are authors or co-authors of three of these papers). Three chapters emphasize previous studies on fruiting body development, especially those in *Coprinus*. These include Chapter One, "Inside the developing mushroom—cells, tissues and tissue patterns," Chapter Six, "Experimental approaches to the study of pattern formation in *Coprinus cinereus*," and Chapter Seven, "Control of growth and patterning in the fungal fruiting structure. A case for the involvement of hormones." Two chapters deal with hyphal growth; Chapter Two, "A new model for hyphal tip extension and its application to differential fungal morphogenesis," works at the level of the individual hyphal tip, whereas Chapter Three, "Pattern formation and development of the fungal mycelium," considers the dynamics of the vegetative mycelium. Chapter Four reviews "The genetics of morphogenesis in *Neurospora crassa*." Chapter Five reviews "Nuclear changes during fungal development." True to the stated intentions of the editors, these chapters are all written in plain English and should be accessible to all mycologists. The references listed at the end of each chapter will provide access to the literature on fungal developmental biology. An index has been included. The first seven chapters of Patterns in Fungal Development present a useful overview of selected research topics in fungal morphogenesis.

The last chapter, "Patterns in fungal development—fruiting patterns in nature" by Roy Watling seems out of place next to the preceding chapters. In this chapter the author reviews hypothesized relationships between certain basidiomycetes that have differing morphologies, and considers the ontogenetic modifications and ecological circumstances that may have been involved in their evolution. This chapter is about taxonomy and natural history, whereas the other chapters are about mechanisms of development. The fact that the final chapter of this text seems so disconnected from the rest of the book may reflect the primordial condition of fungal developmental biology. In botany and zoology, the fusion of embryology, anatomy, and morphology with phylogenetic studies and developmental genetics has created a new interdisciplinary science of evolutionary developmental genetics that is already providing insight into the origins (ontogenetic and phylogenetic) of morphological diversity. Such an integration is a long way off for mycology. This text will contribute to reaching this goal.

In the context of this review, it is worth considering the prospects for the future of evolutionary developmental mycology. Clearly, progress is being made in the understanding of certain model systems, such as *Coprinus cinereus* (to pick a basidiomycete example). *Coprinus cinereus* displays many properties that make it a tractable experimental organism, including rapid growth to fruition in culture and synchronized meiosis. Nevertheless, it is a remarkable accident of history (dating from the works of Hoffman in 1856 and Bensaude in 1917; see Ainsworth, 1976, Introduction to the History of Mycology) that *Coprinus*, with its unique deliquescent ontogeny, has become a model system for developmental studies that are intended for generalization to other groups. Similarly, *Schizophyllum commune*, another basidiomycete model system, has a unique hymenophore morphology in which the "gills" are split longitudinally and curled back toward the pileus. Future developmental studies should explore model systems that are morphologically similar, and hence easily generalized, to other fungi. In addition, understanding the phylogenetic relationships among the model system organisms and other taxa will enable assessment of homologies that will aid interpretation of the results of studies of the model systems. For example, in basidiomycetes the lamellate hymenophore has probably evolved multiple times. Which basidiomycete gills are homologous to those of *Coprinus*?

Descriptive and phylogenetic mycologists should make themselves aware of the ongoing mechanistic developmental studies (in part by reading this book) and should endeavor to make their research relevant to developmental biology through the design of their taxonomic sampling schemes. At the same time, developmental mycologists should consider phylogenetic relationships and hypotheses of morphological homology when generalizing from their results in model systems. Fungal systematists and developmental biologists can and should work together for mutual enlightenment. It is therefore troubling that a strong sentiment is expressed in Chapter One, by Moore, that the observations of traditional fungal taxonomists are of little value to developmental biologists. For example, the following quotation (p. 20) refers to a description of the cystidia of *Coprinus* by Alexander Smith: "According to Smith (1966), cystidia '...occur haphazardly in the hymenium, depending on the species, and vary from abundant to absent...'; a description of a cell distribution pattern which, in terms of developmental biology is totally useless....Much of the literature dealing with cystidia is similarly blinkered, considering them from the taxonomic viewpoint." This attitude is unfortunate because it dismisses the massive literature of descriptive mycology which provides the context for studies of model systems, and ultimately suggests whether their results can be generalized to other organisms. The chosen passage from Smith indicates that there is variability in the ontogeny of cystidia in *Coprinus* species, with some taxa apparently lacking cystidia altogether. Contrary to the opinion expressed by Moore, such information should be of great value to developmental biologists. If some taxa of *Coprinus* lack cystidia, then surely cystidium formation is not a highly conserved, integral aspect of fruiting body ontogeny in the genus as a whole, let alone all agarics.

In the conclusion to Chapter One (p. 32), Moore writes "Significant advances in fungal developmental biology will only be achieved if more use is made of quantitative methods. The science is doomed to stagnation if, in the days of computer-aided image analysis and virtual reality, the practitioners of mycology remain satisfied with hand drawn line art and subjective verbal descriptions to communicate their observations. Fungal developmental biology must get into the 20th century before the 21st brushes it aside." To this, we might add that fungal developmental biologists must strive to place their work in a comparative phylogenetic context if the products of their labors are to have relevance beyond their model systems. *D.S.H.*

MYCOTAXON

Volume LXI, pp. 493 January-March 1997

NOTICE: **K. VÁNKY, USTILAGINALES EXSICCATA No. 1000**

The Herbarium Ustilaginales Vánky (HUV) is a private herbarium. It started its activity in 1954 in Romania, continued in Sweden (between 1970–1986) and in Germany (1986–). The HUV **manages a collection of Ustilaginales**, containing at present 18020 samples, of which a great number are type specimens (holotypes, isotypes, lectotypes, topotypes, etc.). The HUV **arranges exchange** of smut fungi on a one-to-one basis. The HUV also **issues and distributes an exsiccata** of smut fungi, "K. Vánky: Ustilaginales exsiccata" (Vánky, Ust.), including smut fungi from all over the world. It is the sole exsiccata of Ustilaginales appearing after the second world-war. In October 1996, fascicles XXXIX–XL (No. 951–1000) of the exsiccata appeared. Nos. 1–800 were distributed each in 70 samples, Nos. 801–1000 in 45 samples. Totally more than 60000 smut fungus specimens of the exsiccata were sent to mycological herbaria or to mycologists from all over the world. The 1000 numbers of the exsiccata represent **56 type specimens**, **402 smut fungus species** on **543 host plant taxa**. On the occasion of the apparition of the 1000th number, a general index was prepared with a smut fungus index, a host plant index, the types distributed in the exsiccata and corrections. A few old and new fascicles of the exsiccata are still available.

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Page 488, Editor's note

line 1	for	*lückengii*	read	*lückingii*
line 4	for	*lueckengii*	read	*lueckingii*

ERRATA, VOLUME SIXTY-ONE

Page	3	line 14	for	*cripa*	read	*crispa*
	53	9	for	*peckians*	read	*peckianus*
	97	31	*for*	enphasized	*read*	emphasized
	103	3	*for*	adjacents	*read*	adjacent
	177	12	for	*Hexagona*	read	*Hexagonia*
	306	4	for	*bunayensis*	read	*bunyensis*
	307	42	*for*	asccospores	*read*	ascospores
	330	2	for	*cokerii*	read	*cokeri*
	331	22	for	*cokerii*	read	*cokeri*
	461	27	for	*subcaesoides*	read	*subcaesioides*
	473	15	for	*Celluoderm*	read	*Celluloderma*

INDEX TO FUNGOUS AND LICHEN TAXA, VOLUME SIXTY-ONE

This index includes names of genera, infrageneric taxa, species, and infraspecific taxa, as well as new names of suprageneric taxa. All new names are in CAPITALS. The page number on which a new name is proposed is followed by an asterisk (*).

Acanthophiobolus 61: 307
Acaulospora
  appendicula 61: 201
  bireticulata 61: 193-196, 198-201
  cavernata 61: 200-201
  denticulata 61: 200-201
  elegans 61: 201
  excavata 61: 200-201
  foveata 61: 200-201
  gerdemanii 61: 200-201
  rehmii 61: 200-201
  scrobiculata 61: 200-201
  spinosa 61: 200-201
  sporocarpia 61: 201
  thomii 61: 198
  tuberculata 61: 200-201
Aecidium 61: 52
  ailanthi 61: 50
  alangii 61: 50
  cinnamomi 61: 50
  dispori 61: 51
  elaeagni-umbellatae 61: 51
  epimedii 61: 51
  hydrangeae 61: 51
  machili 61: 51
  philadelphi 61: 51-52
  rubiae 61: 52
Aegerita 61: 314
  candida 61: 312
  tortuosa 61: 312
  viridis 61: 314
Aegeritina 61: 311
  tortuosa 61: 311-313
Agaricus
  pleropus 61: 411
  pteropus 61: 411
  tortilis 61: 206
Agonimia
  tristicula 61: 128
Alternaria
  alternata 61: 13
  brassicae 61: 13
Amandinea
  puncata 61: 133
Amanita 61: 389-391, 396, 409
 Sect. Amanita 61: 390-391
 Sect. Amidella 61: 391, 415
 Sect. Lepidella 61: 389-391, 403, 409, 412
 Sect. Phalloideae 61: 390-391, 413
 Sect. Vaginatae 61: 389-391, 415
 Sect. Validae 61: 391, 412
 Subsect. Solitariae 61: 409-410
 Stirps Polypyramis 61: 409
  AFROSPINOSA 61: 389, 403, 407*-408
  agglutinata 61: 36
  aurea 61: 391, 395, 399
  boudieri 61: 409
  calopus 61: 392, 394, 397
  casearea 61: 36
  echinocephala 61: 409
  elegans 61: 391, 393-394
  excelsa 61: 398
  flammeola 61: 392, 399-400
  foetidissima 61: 403-404, 408
  gossensiae 61: 416
  hemibapha 61: 401
   ssp. similis 61: 393
  infusca 61: 392, 402, 406
  loosii 61: 393
  mafingensis 61: 392, 399-400, 402
  MIOMBOENSIS 61: 389, 403, 409*, 414
  muscaria 61: 391
  phalloides 61: 413
  pleropus 61: 403, 406, 411-412
  praeclara 61: 403, 405-406
  princeps 61: 393
  roseolescens 61: 405
  rubescens 61: 398, 412, 414
  solitaria 61: 409
  strobilaceovolvata 61: 392, 396, 397-399
  strobiliformis 61: 409
  subviscosa 61: 414-415
  umbrina 61: 402
  veldiei 61: 409-410
  virginea 61: 410
  zambiana 61: 391-392, 394
Amanitopsis
  aurea 61: 395
  calopus 61: 397
  fibrillosa 61: 396-397
  strobilaceovolvata 61: 396
Amidella
  subviscosa 61: 415
Amyloporia 61: 424
Anaptychia 61: 99
Anema 61: 128
Antridiella
  versicutis 61: 41
Antrodia 61: 424
Aporpium 61: 178, 180
  borneensis 61: 180-181
  dimidiatum 61: 180-181
  hexagonioides 61: 180

- Ariella
  - elegans 61: 393
- Arthonia
  - galactites 61: 138
  - muscigena 61: 138
  - radiata 61: 138
- Arthuriomyces
  - peckianus 61: 52-53
    - var. VERRUCOSUS 61: 49-50, 52*-53
- Ascobolus 61: 163
- Ascochyta
  - cucumeris 61: 13
  - lysimachiae 61: 28
  - phaseolorum 61: 14
- Ascodesmis 61: 162
- Aspergillus 61: 185, 189
  - Subg. Circumdati 61: 185, 189
  - Sect. Flavi 61: 185, 189
    - CAELATUS 61: 185, 186*-190
    - flavus 61: 185, 189
    - nomius 61: 185
    - parasiticus 61: 185, 189
    - tamarii 61: 185, 188-190
- Aspicilia
  - aquatilis 61: 135
  - calcarea 61: 116, 131, 146, 437
  - contorta 61: 116, 122, 131, 146
  - radiosa 61: 437
- Asteroma
  - frondicola 61: 14
- Auricularia
  - polytricha 61: 35
- Bacidia 61: 106, 135
  - rubella 61: 453
- Bacidina
  - arnoldiana 61: 127
  - delicata 61: 127
- Bactrospora 61: 458
  - NAMIBIENSIS 61: 455, 457*-459
- Bagliettoa 61: 122
- Bahusutrabeeja 61: 303, 305
  - angularis 61: 305-306
  - BUNYENSIS 61: 303*-306
  - dwaya 61: 305-306
  - globosa 61: 305
- BELLEMERELLA 61: 443*, 450, 452-453
  - TRAPELIAE 61: 441-443*, 445-450, 453
- Beloniella
  - brunellae 61: 235
  - prunellae 61: 236
- Biscogniauxia 61: 280
- Blastospora
  - itoana 61: 53
- Bjerkandera
  - adusta 61: 41
- Buellia 61: 99
  - badia 61: 113
  - griseovirens 61: 127
- Bulbillomyces
  - farinosus 61: 312
- Caloplaca 61: 119, 434, 451, 453, 456
  - atroflava 61: 135
  - aurantia 61: 116, 119, 131, 146, 437
  - cerinella 61: 138
  - citrina 61: 125
  - elegantissima 61: 456
  - erythrocarpa 61: 437
  - eudoxa 61: 456
  - flavescens 61: 122, 131
  - haematites 61: 138
  - namibensis 61: 456
  - ochracea 61: 128
  - phlogina 61: 137
  - proteus 61: 433-434, 436-439
  - saxicola 61: 125
  - subpallida 61: 113, 135
  - variabilis 61: 128, 437
- Calvatia 61: 381
  - caelata 61: 40
    - f. hungarica 61: 382
  - cretacea 61: 381
  - lloydii 61: 381
  - sculpta 61: 383
  - tatrensis
    - var. gruberi 61: 383
  - utriformis 61: 381-386
    - var. gruberi 61: 382-384, 386
    - var. hungarica 61: 382-383
    - var. utriformis 61: 382-383
- Camillea 61: 280
- Candelariella
  - aurella 61: 133
  - medians 61: 125
  - vitellina 61: 113, 125, 141
- Cantharellus 61: 390
- Catapyrenium
  - pilosellum 61: 128
- Catillaria
  - atomarioides 61: 135
- Ceratorhiza 61: 338
- Cercospora 61: 23, 370
  - ajrekari 61: 370
  - aleuritidis 61: 20
  - atromarginalis 61: 22
  - bidentis 61: 14
  - buddleiae 61: 22
  - cardaminae 61: 14
  - coalescens 61: 363
  - coriariae 61: 23
  - eupatorii-odorati 61: 366, 368
  - heteromalla 61: 23
  - humuli 61: 23
  - miurae 61: 15
  - murina 61: 16
  - nandinae 61: 23
  - paederiae 61: 23
  - puerariicola 61: 24
  - rosicola 61: 14
  - rubi 61: 24
  - rubro-tincta 61: 371
  - sojina 61: 15
  - squalidula 61: 24

- Cercosporidium
  - miurae 61: 15
  - sojinum 61: 15
- Cercysporium
  - rubellum 61: 26
- Cerinomyces 61: 343-346
  - aculeatus 61: 343
  - albosporus 61: 343, 345-346
  - altaicus 61: 343, 346
  - canadensis 61: 343, 346
  - ceraceus 61: 343, 346
  - crustulinus 61: 343, 346
  - CURVISPORUS 61: 343, 344*-346
  - grandinioides 61: 343, 346
  - lagerheimii 61: 343, 346
  - pallidus 61: 343, 346
- Chaetosphaerulina 61: 307
  - BAMBUSAE 61: 307-309*
  - vermicularispora 61: 307
  - yasudae 61: 307
- Chalara 61: 303
  - australis 61: 303, 306
  - DRACOPHYLLI 61: 306*
- Cheiromoniliophora 61: 319
  - elegans 61: 320
  - GRACILIS 61: 319, 320*-321, 323
- Chlorociboria
  - aeruginascens 61: 3-7
- Choiromyces 61: 164
- Ciboria
  - peckiana 61: 3, 7
- Cladosporium 61: 482
  - allii-cepae 61: 15
  - cladosporioides 61: 482
  - herbarum 61:15
  - tenuissimum 61: 15
- Clathrosphaerina 61: 311
  - zalewskii 61: 311-313
- Clauzadea
  - immersa 61: 128
  - monticola 61: 116, 128
- Clitocybe
  - proxima 61: 206
- Coleopucccinia 61: 53-54
  - simplex 61: 53-54
  - sinensis 61: 54
- Coleopucciniella 61: 54
- Coleosporium
  - asterum 61: 54
  - cacaliae 61: 55
  - carpesii 61: 55
  - cimicifugatum 61: 55
  - clematidis 61: 56
  - evodiae 61; 56
  - hiratsukanum 61: 56-57
  - ligulariae 61:56
  - lycopi 61: 49-50, 56-57
  - paederiae 61:57
  - phellodendri 61: 57
  - pini-asteris 61: 55
  - plectranthi 61: 58
  - saussureae 61: 58
- Collema 61: 128
- Colletotrichum
  - tricyrtii 61: 15
- Colpoma
  - verrucosum 61: 237
- Coltricia 61: 419
  - PARVULA 61: 419*
  - perennis 61: 41
  - pusilla 61: 419
- Coltriciella 61: 419
  - PUSILLA 61: 419*
- Coniothyrium 61: 347, 350, 357
  - henriquesii 61: 350, 355, 357
- Conradia 61: 88, 93-94
- Coprinus
  - micaceus 61: 36
- Coronoplectrum 61: 456
- Crepidotus
  - mollis 61: 36
- Crocicreas
  - cyathoideum 61: 7
- Cronartium
  - quercuum 61: 58
  - ribicola 61: 58
- Crucibulum
  - laeve 61: 42
- Curvularia
  - prasadii 61: 15
- Cylindrosporium
  - capsellae 61: 25
- Cystoderma
  - amianthinum 61: 36

- Daedalea 61: 177, 421, 424
  - dickinsii 61: 42
  - quercina 61: 424-425
  - XANTHA 61: 421*, 423, 425
- Daedaleopsis
  - tricolor 61: 42
- Daldinia 61: 243-250, 255, 257, 259, 262, 269-270, 273, 275, 277-278, 281-282
  - Subg. Ento-Daldinia 61: 250
  - Subg. Entodaldinia 61: 277
  - Subg. Eu-Daldinia 61: 250
  - Subg. Eudaldinia 61: 277
  - albozonata 61: 258-259, 277, 286
  - angolensis 61: 277
  - aparaphysata 61: 256, 258, 278
  - argentinensis 61: 258-259, 278
    - var. sessilis 61: 258-260, 278
  - aspera 61: 278
  - asphalatum 61: 278
  - bakeri 61: 250-253, 278, 286
  - BAMBUSICOLA 61: 243-244, 250, 253*-255, 263, 278, 286-287
  - barbata 61: 258-259, 278
  - BRACHYSPERMA 61: 243, 252, 255*, 278, 286
  - caldariorum 61: 243-244, 246, 250, 252, 255-258, 278-281, 286-287
  - californica 61: 272

- [Daldinia] cingulata 61: 278
  - clavata 61: 249, 252, 254-255, 257-260, 265, 277-279, 286-287
  - cognata 61: 255-257, 278
  - concentrica 61: 243-247, 249-251, 254, 257, 260, 262-263, 266-267, 270, 273-274, 278-281, 286-287
    - var. eschscholzii 61: 265, 279
    - var. microspora 61: 279, 282
    - var. minuta 61: 261-262, 279
    - var. obovata 61: 268, 279
    - f. californica 61: 271-272, 279, 286
    - f. clavata 61: 258, 279
    - f. confluens 61: 261-262, 279
    - f. intermedia 61: 261-262, 279
  - confluens 61: 262
  - corrugata 61: 255, 258, 279
  - cudonia 61: 249, 252, 259, 263-264, 274, 279, 281, 286
  - cuprea 61: 249-251, 259-260, 264-265, 279-280, 286
  - durissima 61: 279
  - eschscholzii 61: 252-253, 255, 257-258, 260, 262, 265-267, 276, 279-282, 286-287
  - exsurgens 61: 280
  - feei 61: 280
  - fissa 61: 244, 246, 252-253, 267-270, 273, 275, 278-281, 286
  - GELATINOSA 61: 243, 252, 269*-270, 275, 280, 286
  - gollani 61: 254-255, 257, 280
  - graminis 61: 244, 251, 271, 277, 280, 286-287
  - grandis 61: 250, 252, 267, 271-274, 276, 279-280, 286-287
  - granulosa 61: 264-265, 280
  - hibiscus 61: 255-256, 280
  - intermedia 61: 262, 274
  - LLOYDII 61: 243, 249, 252, 273*, 280, 286
  - loculata 61: 252, 264, 267, 272-274, 276, 280-281, 286
  - luzonensis 61: 265-267, 280, 286
  - MACROSPORA 61: 243, 252, 274*-275, 280, 286
  - malleola 61: 280
  - MEXICANA 61: 243, 250-251, 270, 275*, 280, 286
  - murrillii 61: 263-264, 281
  - occidentalis 61: 273-274, 276, 281, 286
  - PETRINIAE 61: 243-244, 250, 252, 275*-276, 281, 286-287
  - placentiformis 61: 281
  - platensis 61: 256, 281
  - sacchari 61: 244, 251, 277, 281, 286-287
  - simulans 61: 262, 268-269, 281, 286
  - stratosa 61: 265, 281
  - thouarsiana 61: 281
  - tuberosa 61: 260281
  - vernicosa 61: 244, 246, 257, 268-269, 278, 281, 286
    - f. microspora 61: 279, 282
  - warburgii 61: 282
- Dematium
  - herbarum 61: 15
- Depazea
  - frondicola 61: 14
  - salicicola 61: 29
- Dermatea
  - houghtonii 61: 230
- Diploschistes
  - scruposus 61: 113
- Diplotomma
  - alboatrum 61: 138
- Discina 61: 162
- Dothidea
  - ranunculi 61: 236
- Dothiorella 61: 354
- Drechslera
  - turcica 61: 16

- Elaphomyces 61: 155, 158, 163-165
- Elmerina 61: 177-178, 180-181
  - cladophora 61: 178, 180-181
  - foliacea 61: 177-179, 181-182
  - holophaea 61: 177-178
- Endophyllum
  - maheshwarii 61: 59
- Entonaema 61: 247-248
- Epulorhiza 61: 335, 337-338, 340
  - albertaensis 61: 340
  - anaticula 61: 341
  - calendulina 61: 340
  - INQUILINA 61: 335-336, 338*-340
  - repens 61: 341
- Evernia
  - prunastri 61: 123

- Fabraea 61: 235
  - brunellae 61: 235
  - saniculae 61: 235, 237
- Favolus 61: 177
- Fischerula 61: 165
- Flabellophora
  - licmophora 61: 42
- Fomes
  - fomentarius
    - ssp. fomentarius 61: 42
  - marginatus 61: 42
- Frullania 61: 123
- Fulgensia
  - bracteata 61: 438
- Fuscidea
  - cyathoides 61: 113
  - praeruptorum 61: 104, 113

- Ganoderma
  - applanatum 61: 42
  - sinense 61: 43
- Geopora 61: 164
  - cooperi 61: 155

Glomus 61: 198
  caledonium 61: 198
  constrictum 61: 198
  fasciculatum 61: 198
  macrocarpum 61: 198
  microcarpum 61: 198
  occultum 61: 198
Graphiothecium
  vinosum 61: 364, 366
Guignardia
  cytisi 61: 354
Gymnoconia
  interstitialis 61: 52
  peckiana 61: 52
Gymnosporangium 61: 54
  asiaticum 61: 59
  yamadae 61: 59
Gyromitra 61: 162
  esculaenta 61: 162

Haematomma
  ochroleucum 61: 132
Hamaspora
  hashiokae 61: 59
Hebeloma 61: 209, 212
  Sect. Indusiatae 61: 211
    album 61: 211
    cistophilum 61: 209-212
    CREMEOPALLIDUM 61: 209, 212*
    hiemale 61: 211
    mackinawense 61: 212
    mesophaeum 61: 211
    vaccinum 61: 209, 212
      var. cremeopallidum 61: 212
Helicoma
  monospora 61: 30
Helminthosporium
  turcicum 61: 16
Helvella 61: 162
  crispa 61: 3-4
  lacunosa 61: 168
  leucopus 61: 4
Hemisphaeria 61: 249
  concentrica 61: 249, 260, 279
Hendersonia 61: 353, 357
Hendersonula 61: 353
Herpotrichia 61: 307
Heterodermia 61: 99
Heterosporium
  allii-cepae 61: 15
Hexagonia 61: 177
  cladophora 61: 177
Hirschioporus
  elongatus 61: 43
Hyalopsora
  polypodii 61: 59
Hyaloscypha
  lignicola 61: 314
  zalewskii 61: 312
Hydnotrya 61: 164
Hyperphyscia 61: 87-88, 98-99
  adglutinata 61: 87-88, 95-97, 100
  COCHLEARIS 61: 87-88, 94*-97, 99-100
  coralloides 61: 87-88, 91-94, 98-99
  CORONATA 61: 87-89*, 90, 98
  PSEUDOCORALLOIDES 61: 87-88, 90-91*, 93-94, 98-99
  syncolla 61: 99
  tuckermanii 61: 87, 94, 96
  variabilis 61: 87, 94, 96-97, 99
  viridissima 61: 99
Hypochnus 61: 469
Hypodiscus
  exsurgens 61: 280
  placentiformis 61: 281
Hypogymnia
  physodes 61: 123
Hypoxylon 61: 247-248, 250, 278-279
  angolense 61: 277
  annulatum 61: 280
  asphalatum 61: 278
  colensoi 61: 278
  concentricum 61: 260, 269, 279
    var. minus 61: 279
    var. obovatum 61: 269
  durissimum 61: 279
  exsurgens 61: 280
  fissum 61: 273, 280
  fragiforme 61: 247
  fuscum 61: 245
  hibisci 61: 255-257, 280
  malleolus 61: 280
  marginatum 61: 280
  placenta 61: 281
  placentiforme 61: 260, 281
  sclerophaeum 61: 278
  simile 61: 261-262, 281
  stratosum 61: 265-266, 281
  thouarsianum 61: 280-281
  tuberosum 61: 260, 281
  vernicosum 61: 268, 281

Inocybe
  fastigiata 61: 36
  rimosa 61: 36
Inonotus
  radiatus 61: 43
Irpex 61: 469
Isariopsis
  griseola 61: 19

Jafnea 61: 4
  fusicarpa 61: 4
  semitosta 61: 3-4

Karstenula 61: 278
Kirramyces 61: 354
Kretzschmaria 61: 282
  angolensis 61: 277
  colensoi 61: 278

Laccaria 61: 205
  proxima 61: 205-206

[Laccaria] tortilis 61: 205-206
Lachnellula 61: 8
  DABAENSIS 61: 3-4, 7*-8
  subtilissima 61: 7-8
Lachnum
  abnormis 61: 8
  pudibundum 61: 3-4, 9
  sclerotii 61: 9
  virgineum 61: 9
Lactarius 61: 389-390
  piperatus 61: 37
Lanzia
  microserotina 61: 9
Lasallia
  pustulata 61: 115
Lecania
  cyrtella 61: 137
  erysibe 61: 125
  rabenhorstii 61: 125
Lecanographa
  dialeuca 61: 461
  LONGICARPA 61: 455, 460*-462, 465
  lynceoides 61: 463
  subcaesioides 61: 457, 461
  TEHLERI 61: 455, 461*-463, 465
Lecanora
  achariana 61: 135
  adglutinata 61: 97
  albescens 61: 125, 131
  carpinea 61: 138
  chlarotera 61: 141
  crenulata 61: 128
  dispersa 61: 125, 133, 143
  hagenii 61: 133
  muralis 61: 113, 116, 135
  pannonica 61: 141
  pruinosa 61: 128
Leccinum
  scabrum 61: 39
Lecidella
  elaeochroma 61: 123, 138, 141
Lentinus
  edodes 61: 37
  holophaeus 61: 181-182
  lepidius 61: 37
Lenzites 61: 177
  betulina
    var. betulina 61: 43
Lepiota
  pleropus 61: 411
  praeclara 61: 403
  pteropoda 61: 411
Lepraria 61: 123, 127
Leprocaulon
  microscopicum 61: 113
Leproloma
  membranaceum 61: 113, 115
Leptogium
  schraderi 61: 129, 146
Leptosphaeria 61: 347
Leptotrochila 61: 223, 235, 237
  brunellae 61: 235
  ranunculi 61: 235-236
  repanda 61: 238
  verrucosa 61: 235, 237-238
Leucovibrissea 61: 218
Lichenochora 61: 434, 438-439
  constrictella 61: 438
  xanthoriae 61: 433-434, 438-439
Ligniera 61: 327
  verrucosa 61: 332
Lobothallia
  radiosa 61: 129
Lycoperdon
  atrum 61: 260, 278
  fraxineum 61: 260, 280
  perlatum 61: 40

Macrophomopsis
  coronillae 61: 354
Macrosporium
  brassicae 61: 13
  sarciniforme 61: 30
Marasmius
  ramealis 61: 37
Marsonia
  mali 61: 16
Marssonina
  mali 61: 16
Melampsora
  abietis-populi 61: 59
  epitea 61: 60
  euphorbiae 61: 60
  idesiae 61: 60
  kusanoi 61: 60
  magnusiana 61: 61
  yezoensis 61: 61-62
Melampsoridium
  carpini 61: 62
Melampylidium 61: 460
Melanelia
  glabratula 61: 112, 123
Melanotaenium 61: 359, 361-362
  adoxae 61: 359-362
  ari 61: 359-362
Membranosorus 61: 327
  heterantherae 61: 327-328, 331-333
Merulius 61: 469
  tremellosus 61: 43, 469-470
Micarea
  prasina 61: 127
Microdiplodia 61: 350
Microporus
  xanthopus 61: 43
Microsphaeropsis 61: 347, 350, 354-355, 357
Milesina
  exigua 61: 62
Miyagia
  anaphalidis 61: 62
Morchella 61: 162
  elata 61: 5

Muellerella 61: 441-442, 450, 452-453
    hospitans 61: 450, 453
    lichenicola 61: 450-451, 453
    polyspora 61: 450, 452-453
Mycosphaerella
    aleuritidis 61: 20
    confusa 61: 24
    personata 61: 25
    pueraricola 61: 24
Mycovellosiella 61: 368, 370
    eupatorii-odorati 61: 368
    ferruginea 61: 22
    hyalofilispora 61: 18
    murina 61: 16
    PHILADELPHI 61: 13, 16*-17, 33
    salicis 61: 18
Myrothecium 61: 81-82, 85
    atrum 61: 81, 85
    flavo-virens 61: 81, 85
    gramineum 61: 85
    leucotrichum 61: 85
    mori 61: 81, 85
    RENAUDII 61: 81, 82*-85
    roridum 61: 81
    viride 61: 81

Neofuscelia 61: 456
    follmannii 61: 456
    incomposita 61: 456
    lagunebergensis 61: 456
    loxodes 61: 113
    namaensis 61: 456
    pulla 61: 113
    tentaculina 61: 456
Neohendersonia 61: 353
Neohypodiscus
    cerebrinus 61: 278
Nidula
    niveo-tomentosa 61: 43
Nodulisporium 61: 247-248, 250, 256, 259, 261, 263, 265, 268, 273, 276
    tulasnei 61: 263
Nummularia
    placentiformis 61: 281
Nyssopsora
    cedrelae 61: 62

Octosporella 61: 163
Oidium 61: 18
    corticale 61: 314
Oncopodium 61: 319, 325
    aceris 61: 325
    antoniae 61: 325
    cubensis 61: 325
    munjalii 61: 325-326
    panici 61: 325
    PASPALI 61: 319, 322*-326
    pruni 61: 325
    simmonsii 61: 325-326
    suttonii 61: 325
Orbilia
    xanthostigma 61: 9
Ovularia
    bulbigera 61: 19
    obliqua 61: 19
Oxydontia
    chrysella 61: 43

Pachysporaria 61: 88, 93-94, 96-97
Papulaspora 61: 314
    viridis 61: 314
Parahendersonnia
    dasylirionis 61: 353
Paraphaeosphaeria 61: 347, 350, 353-357
    AGAVENSIS 61: 347, 348*-350, 354, 356-357
    NOLINAE 61: 347, 350*, 352-354, 356-357
    obtusispora 61: 347, 350, 353-357
    quadriseptata 61: 347, 350
Parmelia
    glabratula 61: 112, 123
    saxatilis 61: 123
    sulcata 61: 127
    velata 61: 375-376
Periconiella 61: 250, 254-255
Peripherostoma 61: 249
    concentricum 61: 249, 260, 279
Pernospora
    obliqua 61: 19
Pertusaria 61: 375, 377-378, 485
    albissima 61: 486
    commutans 61: 376, 378
    contraria 61: 378
    coralline 61: 132
    hawaiiensis 61: 377-378
    pulchella 61: 376, 378
    rhodotropa 61: 377-378
    santamonicae 61: 377-378
    skottsbergii 61: 377-378
    SPILOTA 61: 485*-486
    subvaginata 61: 377-378
    subvelatula 61: 377-378
    velata 61: 375-378
Petractis
    clausa 61: 129
Pezicula 61: 224-225, 228
    cinnamomea 61: 224-225, 227
    crataegi 61: 228
    EUCALYPTI 61: 224-225*, 228
    houghtonii 61: 224, 230
    linda 61: 224, 232
    rhabarbarina 61: 233
    rubi 61: 224, 228, 233-234
Phacidium
    laurocerasi 61: 240
Phaeoisariopsis
    griseola 61: 19
Phaeophyscia 61: 98-99
    orbicularis 61: 125, 133, 143
Phaeoramularia 61: 363, 366, 370-371
    ajrekari 61: 370
    coalescens 61: 363-366
    eupatorii-odorati 61: 363, 366-368, 370

SEE ERRATA

[Phaeoramularia] gomphrenicola 61: 370
- montana 61: 19
- nepalensis 61: 370
- pruni 61: 20, 363, 369-371
- pyricola 61: 371
- pyrigena 61: 371

Phaeoseptoria 61: 357
Phaeosphaeria 61: 347, 357
PHAEOSTAGONOSPORA 61: 347, 351*, 353-354
- NOLINAE 61: 351*-353

Phakopsora
- compositarum 61: 62
- pachyrhizi 61: 62

Phellinus
- gilvus 61: 43

Phlebiella 61: 469
Phlyctidium
- saniculae 61: 237

Pholiota
- mutabilis 61: 37
- squarrosoides 61: 37

Phragmidium
- assamense 61: 63
- cinnamomeum 61: 63
- fusiforme 61: 63
- miyakeanum 61: 63
- rosae-multiflorae 61: 64
- rubi-thunbergii 61: 64
- yamadanum 61: 64

Phylacia 61: 248
Phyllosticta
- glycines 61: 20
- phaseolina 61: 20
- pirina 61: 20
- quercus 61: 20

Physcia 61: 89, 97, 99
- adscendens 61: 125, 138
- caesia 61: 125
- coronifera 61: 98
- dubia 61: 113
- tenella 61: 113, 125, 138

Physciopsis
- adglutinata 61: 97

Physconia
- distorta 61: 112
- grisea 61: 138

Physopella
- ampelopsidis 61: 64
- meliosmae 61: 64

Picoa 61: 429-430
- lefebvrei 61: 427-430

Pileolaria
- klugkistiana 61: 64

Piptarthron 61: 350
Placynthium
- nigrum 61: 131

Plasmodiophora 61: 327, 332-333
- brassicae 61: 332

Pleurotus
- dryinus 61: 37
- ostreatus 61: 37

Plurisperma 61: 452-453
Pluteus 61: 473
- Sect. Celluloderma 61: 473
- Sect. Pluteus 61: 473
  - aurantiorugosus 61: 473
  - chrysophlebius 61: 473
  - exilis 61: 473-475
  - globiger 61: 473, 476-478
  - harrisii 61: 473
  - longistratus 61: 38
  - major 61: 474
  - sanctixaverii 61: 473, 477-478

Poculum
- subcinnabarium 61: 10-11

Polymyxa 61: 332
Polyporus
- arcularius 61: 44
- elegans 61: 44
- spatulatus 61: 44
- tenuissimus 61: 44
- xanthus 61: 421

Poria 61: 424
- xantha 61: 421, 424-425

Poronia 61: 298
- ehrenbergii 61: 295-296, 298-300

Protoblastenia
- incrustans 61: 122
- rupestris 61: 122, 437

Protodaedalea 61: 177-178
- hispida 61: 177-178, 181-182

Protomerulius 61: 178, 180-181
- africanum 61: 180
- brasiliensis 61: 181
- caryae 61: 181
- substuppeus 61: 180, 182

Psathyrella
- candolleana 61: 38
- velutina 61: 38

Pseudaegerita 61: 311, 314
- corticalis 61: 311, 314-315
- matsushimae 61: 314
- viridis 61: 314

Pseudocercospora
- aleuritidis 61: 20
- ARTEMISIICOLA 61: 13, 20*-21, 33
- atromarginalis 61: 22
- buddleiae 61: 22
- coriariae 61: 23
- dracunculi 61: 22
- heteromalla 61: 23
- humuli 61: 23
- nandinae 61: 23
- paederiae 61: 23
- paulowniae 61: 23
- puerariicola 61: 24
- rhoidis 61: 24
- rubi 61: 24
- spualidula 61: 24
- toonae 61: 24-25
- vitis 61: 25

Pseudocercosporella
  capsellae 61: 25
Pseudocoprinus
  disseminata 61: 38
Pseudopeziza 61: 223, 241
  medicaginis 61: 241
  repanda 61: 237
  trifolii 61: 241
Psilopezia 61: 6
  DABAENSIS 61: 3-5*
  nummularialis 61: 5-6
Puccinia
  allii 61: 65
  antenori 61: 65
  benguetensis 61: 65
  bolleyana 61: 65
  brachypodii
    var. arrhenatheri 61: 66
    var. poae-nemoralis 61: 66
  brachystachyicola 61: 66
  bupleuri 61: 66
  buxi 61: 49-50, 66
  caricis-blepharicarpae 61: 67
  caricis-japonicae 61: 49-50, 67
  caricis-thunbergii 61: 67
  citrina 61: 68
  coronata
    var. avenae 61: 67
    var. coronata 61: 67
    var. himalensis 61: 68
  dieteliana 61: 68
  dioicae 61: 68
  dioscoreae 61: 68
  ferruginea 61: 68
  fusispora 61: 69
  graminis 61: 69
  haleniae 61: 69
  hanyuenensis 61: 69
  hemerocallidis 61: 69
  hieracii 61: 69
  hikawaensis 61: 52
  iridis 61: 70
  kusanoi 61: 70
  lactucae-debilis 61: 70
  lapathicola 61: 70
  ligusticola 61: 70
  longicornis 61: 70
  melanocephala 61: 71
  menthae 61: 71
  minussensis 61: 71
  nanbuana 61: 71
  neyraudiae 61: 72
  nishidana 61: 72
  oenanthes-stoloniferae 61: 72
  peckiana 61: 52
  pimpinellae 61: 72
  polygoni-amphibii 61: 73
  polygoni-weyrichii 61: 65
  polygonicola 61: 73
  pygmaea 61: 73
  septentrionalis 61: 74
  sorghi 61: 74
  stellariicola 61: 74
  yokogurae 61: 74
Pucciniastrum
  agrimoniae 61: 74
  corni 61: 75
  epilobii 61: 75
  hydrangeae-petiolaris 61: 75
Pucciniostele
  mandshurica 61: 75
Pulveria 61: 248
Pulveroboletus
  ravenelii 61: 39
Pycnoporus
  cinnabarinus 61: 44
Pyrenomyxa 61: 248
Pythium 61: 327
  pulchrum 61: 328

Ramalina 61: 461
Ramularia 61: 366, 370
  celastri 61: 25
  coalescens 61: 364
  euonymi 61: 25
  montana 61: 19
  picridis 61: 25
  plantaginis 61: 26
  rebella 61: 26
  rufomaculans 61: 26
  taraxaci 61: 26
Rhizocarpon
  badioatrum 61: 132
  distinctum 61: 113
  geographicum 61: 132
  riparium 61: 113
  viridiatrum 61: 113, 132
Rhopalopsis
  angolensis 61: 277
Rhopalostroma 61: 248
  angolense 61: 278
Rinodina 61: 99, 103-105, 123, 133
  alba 61: 114
  albana 61: 103, 105
  algarvensis 61: 113
  archaea 61: 103-105, 109, 111-112, 137-138
  aspersa 61: 103-104, 106, 109, 112-114
  atrocinerea 61: 103-105, 109, 113-115, 138
  attica 61: 131
  badiella 61: 104-105
  beccariana 61: 120
  bischoffii 61: 103-105, 110, 115-116, 128-129, 145
  calcarea 61: 103-106, 110, 116, 118-119, 144, 146
  colobina 61: 104, 136-137
  confragosa 61: 103, 105, 110, 119-120, 132, 138
  conradii 61: 99, 103, 105-108, 120-121
  dubyana 61: 103-106, 111, 116, 121-122, 128, 146

[Rinodina] efflorescens 61: 103-106, 108, 122-123, 127, 145
  exigua 61: 103-104, 124-125, 132-133
  fatiscens 61: 112-113
  gennarii 61: 103-105, 107, 111, 124-125, 133
  griseosoralifera 61: 103-106, 108, 123, 127
  guzzinii 61: 116
  horiza
    var. albana 61: 103, 105
  hueiana 61: 122
  immersa 61: 103-106, 110, 115, 122, 128-129, 146
  inflata 61: 127
  interpolata 61: 103-106, 111, 129-130, 132, 138, 140
  lecanorina 61: 103-106, 111, 116, 118, 130-131
  luridata 61: 130
  metabolica
    α exigua 61: 103
  occulta 61: 103, 105-106, 110, 120, 129, 131-132, 140
  ocellata 61: 104, 130
  oleae 61: 103-105, 109, 125, 132-133, 145
  oxydata 61: 103-106, 110, 134-136, 142-143, 145
  pityrea 61: 103-107, 109-110, 118, 136-137, 146
  pyrina 61: 103-105, 109, 112, 137-138
  sicula 61: 103-105, 109, 114, 129-130, 138, 140
  sophodes 61: 103-105, 109, 141
  subexigua 61: 104, 124-125
  teichophila 61: 103-106, 111, 135, 142-144
  tephraspis 61: 104-105
  tunicata 61: 103-106, 110, 118-119, 122, 144, 146
  vezdae 61: 103, 105, 134-135, 142
Rosellinula 61: 450
Ruhlandiella 61: 164
Russula 61: 389-390
  delica 61: 38
  erythropus 61: 38
  foetens 61: 38
  lactea 61: 38
  senecis 61: 39
  virescens 61: 39
  xerampelina 61: 39
Rutstroemia
  DABAENSIS 61: 3-4, 10*

Santessonia 61: 456
  hereroensis 61: 461
  lagunebergii 61: 461
  namibensis 61: 458
  sorediata 61: 461
Sarcosoma
  mexicanum 61: 168
Schizophyllum
  commune 61: 39
Scoliciosporum
  umbrinum 61: 113, 132
Scolicotrichum
  bulbigerum 61: 19
Scutellinia
  pennsylvanica 61: 3, 6
  subhirtella 61: 6
Selenaspora
  guernisacii 61: 159, 169
Selenophoma 61: 354
  juncea 61: 354
Septonema
  vitis 61: 25
Septoria
  agrimoniicola 61: 26
  aquilina 61: 29
  argyrea 61: 26
  artemisiae 61: 26
  cirsii 61: 26
  coriariae 61: 27
  cornicola 61: 27
  dearnessii 61: 27
  erigerontis 61: 27
  fullonum 61: 27
  helianthi 61: 27
  inconspicua 61: 27
  jenissensis 61: 28
  lysimachiae 61: 28
  patriniae 61: 28
  plantagina 61: 28
  polygonorum 61: 28
  prenanthis 61: 28
  pteridis 61: 29
  rubi 61: 29
  salicicola 61: 29
  stigma 61: 29
  symploci 61: 29
  tinctoria 61: 29
  viburni 61: 30
Serenomyces 61: 481
  californicus 61: 481-482, 484
  palmae 61: 481
  phoenicis 61: 481
  VIRGINIAE 61: 482*, 484
Setosphaeria
  turcica 61: 16
Sirococcus
  spiraeae 61: 30
Sirodiplospora
  spiraeae 61: 30
Skeletocutis
  nivea 61: 44
Solenopsora
  candicans 61: 131
Sonderhenia 61: 354
Sorodiscus 61: 327-328, 331-333
  callitrichis 61: 327-333
  cokeri 61: 327-333
  heterantherae 61: 327
  karlingii 61: 327

[Sorodiscus] radicicolus 61: 327
Sorosphaera 61: 327-328, 332
    veronicae 61: 327-328, 331-332
Sphaeria
    asphalatum 61: 278
    cingulata 61: 278
    concentrica 61: 249, 260, 262, 269, 276, 279
        var. eschscholzii 61: 265-266, 279
        var. obovata 61: 267, 269, 279
        var. pedicellata 61: 267, 269, 279
        var. stipitata 61: 269
    craterium 61: 238
    durissima 61: 279
    eschscholzii 61: 265, 280
    fraxinea 61: 261-262, 280
    loculata 61: 273, 280
    placenta 61: 281
    punctiformis
        β hederae 61: 238
    thouarsiana 61: 281
    tuberosa 61: 260, 281
    tunicata 61: 261, 281
    vernicosa 61: 268, 280-281
Sphaerosoma 61: 164
Spirosphaera 61: 311, 317
    floriformis 61: 311, 314-315
    minuta 61: 311, 316-317
Spongipellis
    litschaueri 61: 44
Spongospora 61: 327
    subterranea 61: 332
Sporisorium
    reilianum 61: 47
Sporothrix 61: 250, 253, 268, 276
Stagonospora 61: 353
Steccherinum
    cirrhatum 61: 44
Stemphylium
    sarciniforme 61: 30
Strangospora
    pinicola 61: 133
Stromatosphaeria 61: 249
    concentrica 61: 260, 279
Subulicystidium 61: 312
    longisporum 61: 312
Suillus
    albidipes 61: 39
    granulatus 61: 40
Synalissa
    symphorea 61: 129

Tarzetta
    cupularis 61: 6
Teloschistes 61: 456
    capensis 61: 456
    chrysocarpoides 61: 456-457
    puber 61: 456
Terana 61: 469
Terfezia 61: 427-430
    arenaria 61: 427-430
    boudieri 61: 427-430
    claveryi 61: 428
Thamnomyces 61: 248
Thaxteriellopsis
    bambusicola 61: 307
Thelidium 61: 129
Thyrea
    pulvinata 61: 129
Tirmania 61: 427, 429-430
    nivea 61: 427-430
    pinoyi 61: 427-430
Toninia
    tumidula 61: 129
Torula
    alternata 61: 13
Trametes 61: 177
    gibbosa 61: 45
    hirsuta 61: 45
    versicolor 61: 45
Tranzschelia
    fusca 61: 75
Trapelia
    involuta 61: 115, 132, 441-443, 445
Tremella
    aurantia 61: 36
Trichaptum
    abietinum 61: 45
Tricholomopsis
    platyphylla 61: 39
Trichoramalina
    melanothrix 61: 461
Tripospermum
    juglandis 61: 30
    myrti 61: 30
Triposporium 61: 225
    juglandis 61: 30
    myrti 61: 30
Trochila 61: 224, 238
    craterium 61: 238-239
    ilicina 61: 238-239
    ilicis 61: 239-240
    laurocerasi 61: 238, 240
Troposporella
    monospora 61: 30
Tuber 61: 155, 165, 427, 429
    californicum 61: 7
    melanosporum 61: 168, 428-430
Tubercularia
    guttata 61: 428
Tubeufia 61: 307
Tyromyces 61: 177
    amygdalinus 61: 45

Uredinopsis
    hirosakiensis 61: 76
    struthiopteridis 61: 76
Uredo
    alpestris 61: 76
    grewiae 61: 76
    yamadana 61: 76
Urocystis
    japonica 61: 47
    ulei 61: 47-48

Uromyces
  appendiculatus 61: 76
  ervi 61: 77
  fallens 61: 77
  geranii 61: 77
  kaimontanus 61: 77
  lespedezae-procumbentis 61: 78
  mucunae 61: 78
  polygoni-avicularis 61: 78
  rugulosus 61: 78
  scaberulus 61: 78
  trifolii 61: 78
  trifolii-repentis 61: 77
Usnea 61: 461
Ustilago 61: 362
  adoxae 61: 359
  calamagrostidis 61: 48
  commelinae 61: 48
  hordei 61: 48
  maydis 61: 48
  nepalensis 61: 48
  striiformis 61: 48
  syntherismae 61: 48
Ustulina 61: 282

Valsa
  tuberosa 61: 260, 281
Verpa 61: 162
Verrucaria 61: 129, 434
  caerulea 61: 122
  granulosaria 61: 434
  nigrescens 61: 116
  protearia 61: 440
Versiomyces
  cahuchucosus 61: 269
Vibrissea 61: 215, 218
 Sect. Apostemium 61: 215, 218
 Sect. Leucovibrissea 61: 215
 Sect. Microstemium 61: 215, 218, 220
 Sect. Vibrissea 61: 218, 220
  leucocephala 61: 218
  PFISTERI 61: 215, 216*-220
  strossmayerioides 61: 220
Virgariella 61: 250, 268, 272
Volvariella
  volvacea 61: 395

Weddellomyces 61: 434, 436
  aspiciliicola 61: 437
  epicallopisma 61: 437
  erythrocarpae 61: 433-434, 436-437
  heterochrous 61: 436-437
  macrosporus 61: 437
  pachyosporicola 61: 437
  PROTEARIUS 61: 433-434*, 435-437
Woronina 61: 333
  cokeri 61: 327, 333
  pythii 61: 328, 331-333

Xanthodactylon 61: 457
  flammeum 61: 461
Xanthomaculina 61: 457
  convoluta 61: 457
  hottentota 61: 457, 461
Xanthoparmelia
  conspersa 61: 113
  mougeotii 61: 132
Xanthoria 61: 138
  elegans 61: 434, 438-439
  parietina 61: 125, 133, 138, 143
  turbinata 61: 461
Xenodochus
  carbonarius 61: 79
Xepicula 61: 85
  leucotricha 61: 85
Xepiculopsis 61: 85
  graminea 61: 85
Xylaria 61: 243, 280, 298
  cudonia 61: 263-264, 279
  vernicosa 61: 280
Xylosphaera 61: 298
  ehrenbergii 61: 295-296

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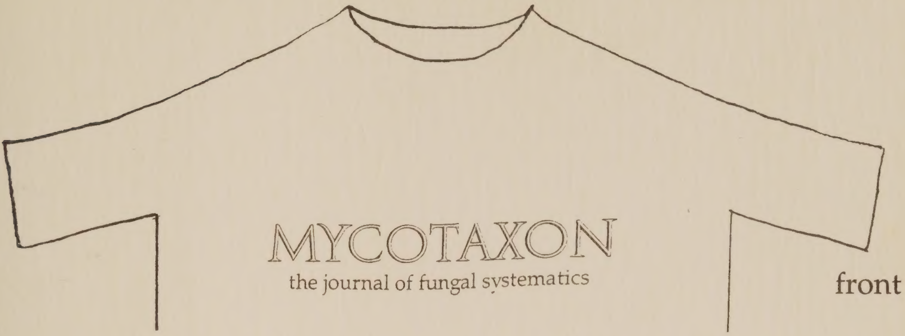
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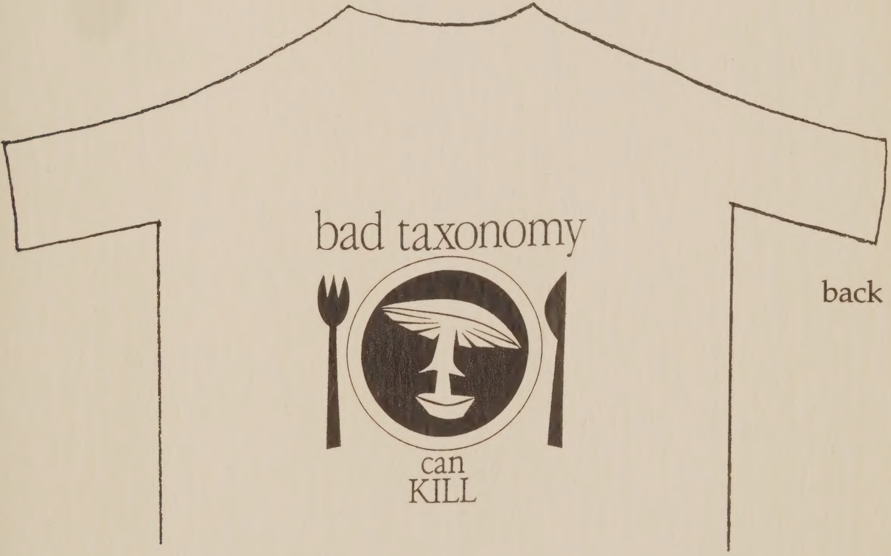
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